Technical Description
703010En, Ed. 3, Rev G
June 2007

TankRadar® REX

High Precision Tank Gauging System

ROSEMOUNT® Tank Gauging

www.rosemount-tg.com

EMERSON™ Process Management

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Available technical documentation for TankRadar Rex:

- Technical Description
- Installation Manual
- TankMaster WinSetup User's Guide
- TankMaster WinOpi User's Guide
- Commissioning Manual & Checklist
- Installation Drawings
- Service Manual

The Technical Description includes technical data on the various parts of the TankRadar Rex system.

The Installation Manual is used for planning and performing the installation.

The Commissioning Manual & Commissioning Checklist include information on how to commission the TankRadar Rex System. They are used together with the TankMaster WinSetup User's Guide.

The TankMaster WinSetup User's Guide describes how to start-up the system using the WinSetup software on a personal computer. TankMaster is the Human Machine Interface (HMI) software for TankRadar Rex. It includes the WinSetup and WinOpi software modules.

The TankMaster WinOpi User's Guide describes the inventory and display functions included in the optional TankMaster WinOpi software.

The Service Manual is used for service and trouble shooting.

Abbreviations used in this document:

APC	Analog Processing Card
API	American Petroleum Institute
DAU	Data Acquisition Unit
DCS	Digital Control System.
EEPROM	Electrically Erasable Programmable Read Only Memory
FBM	Field Bus Modem
FCC	Field Communication Card
FCU	Field Communication Unit
FMCW	Frequency Modulated Continuous Wave
FSK	Frequency Shift Keyed
HMI	Human Machine Interface
IS	Intrinsically Safe
ISO	International Standard Organization
JB	Junction Box
LCD	Liquid Crystal Display
OIML	International Organization of Legal Metrology
PC	Personal Computer
PCB	Printed Circuit Board
PROM	Programmable Read Only Memory
PTB	Physikalisch Technische Bundesanstalt
PTFE	Polytetrafluoroethylene.
RDU	Remote Display Unit
RF-head	A device for emitting and receiving microwaves.
ROC	Relay Output Card
RTD	Resistance Temperature Detectors
RTG	Radar Tank Gauge
SCADA	Supervisory Control and Data Acuisisition System
SPC	Signal Processing Card
TH	Transmitter Head
THE	Transmitter Head Electronics
TIC	Transmitter Interface Card
TM	TankMaster
TMC	Transmitter Multiplexer Card
TRC	Transformer Rectifier Card
TRL	TankRadar L (First generation)
TÜV	Technischer Übervachungs-Verein
VAC	Volts Alternating Current
VDC	Volts Direct Current

TankRadar Rex – the industry standard tank gauging system

TankRadar Rex is a state-of-the art inventory and custody transfer radar tank gauging system for storage tanks. It fulfills the highest requirements on performance and safety. The development of TankRadar Rex is based on 25 years experience in radar level gauging. More than 100 000 radar gauges have been delivered.

Features

- Excellent reliability (gauge MTBF is 112 years).
- Highest accuracy with custody transfer approvals, including OIML certificate.
- Drip-off antennas according to API.
- Antennas for all types of tanks.
- Proven performance and installations at all major oil companies.
- Method for accurate measurements in still-pipes, invented and patented for the TankRadar® products.
- Overfill protection certified by TÜV for high environmental safety.
- Gauge emulation for cost-effective installation in systems supplied by other vendors.
- All functions for complete tank farm monitoring available in one system.
- OPC compatible HMI software.
- Worldwide service and support.

Applications

Bulk liquid storage tanks at:

- Refineries
- Independent tank terminals
- Marketing terminals
- Pipeline terminals
- Petrochemical industry
- Liquefied gas terminals
- Aviation fuel depots

The extensive range of TankRadar Rex RTG 3900 Series level gauges fits all types of tanks, fixed or floating roofs, pressurized or non-pressurized. The TankRadar Rex system measures the entire storage tank site.

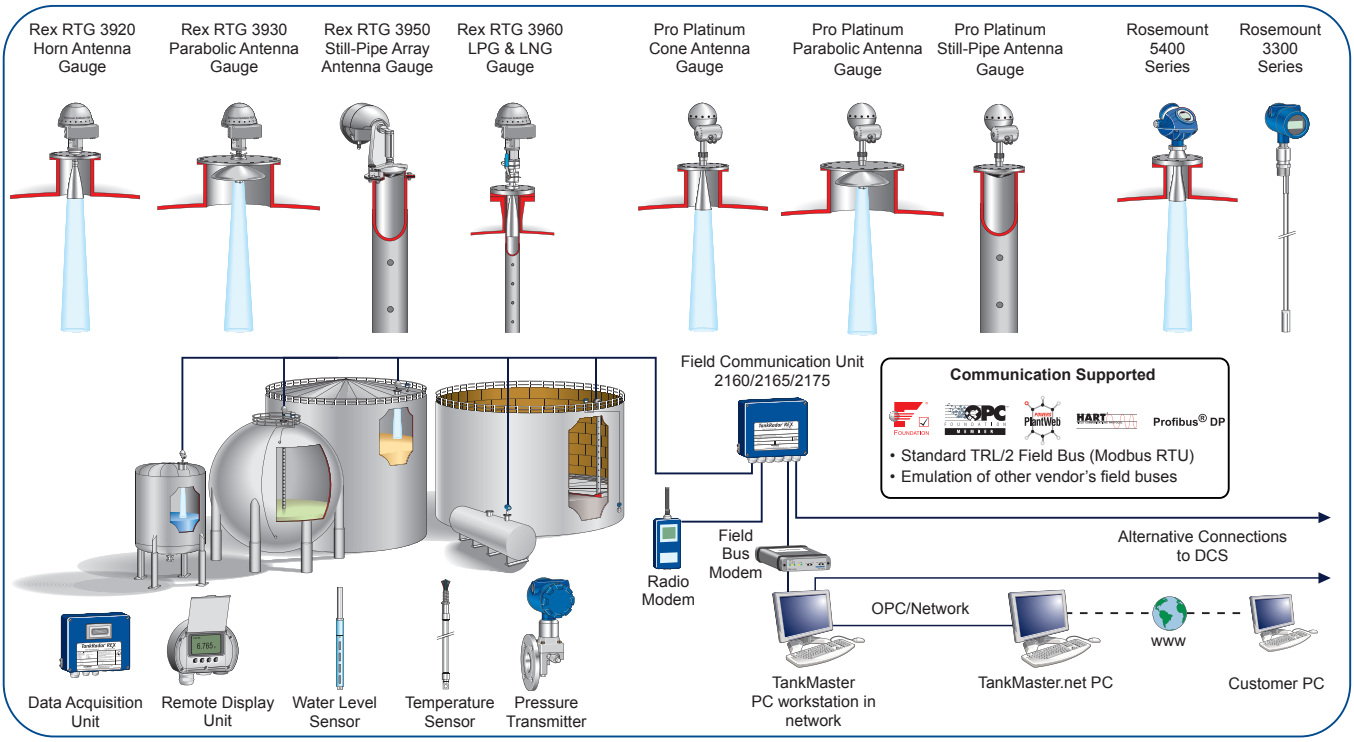
Summary of functions & system overview

TankRadar Rex system measures and calculates tank data for:

- Inventory calculations
- Custody transfer
- Oil movement
- Loss control
- Operational & blending control
- Leak detection and overfill protection

The system is configured with the functions as required by the user. Available functions are:

- Level, temperature, and water interface level measurement.
- Vapor pressure and hydrostatic pressure measurement.
- Total Observed Volume (TOV), and observed density calculations in the gauge.
- Net volume calculations according to API (with the TankMaster software package).
- Complete inventory, hybrid and custody transfer functions (with the TankMaster software package).
- FOUNDATION™ fieldbus, Profibus DP, Tiway and proprietary TRL/2 bus communication.
- Emulation of other field buses for cost efficient installation in older systems delivered by other vendors.
- Built-in multiple temperature inputs, analog inputs/outputs, HART inputs for pressure transmitters and relay outputs in radar-gauge.
- Local field display.



TankRadar Rex system overview.

Measured values are communicated on a field bus or directly to a PC. In larger systems there are Field Communication Units (FCU:s) that collect data from separate field buses. In this way both stand- alone gauges and large systems with several hundred gauges are economical and have an excellent performance.

The TankRadar Rex system is configured and operated using the OPC compatible TankMaster software package. Its a user-friendly Human Machine Interface (HMI) software that gives the operator a good overview and quick access to any measured values. The software also provides a wide range of inventory and custody transfer functions such as net standard volumes according to API standards, reporting, alarms, graphics, trends etc.

A whole range of plant host computer systems, DCS or SCADA systems can be connected to the TankRadar Rex system for display of measured and calculated values. Protocols for communication with major suppliers of plant host computers have been developed and certified. TankMaster Rex gauges can also be incorporated in other tank gauging manufacturers' systems using the emulation features.

The TankRadar Rex System can include various integrated equipment, such as:

- Multi-spot temperature sensors.
- Water Interface measurement sensors integrated with temperature sensors.
- Vapor pressure transmitters.
- Hydrostatic pressure transmitters.
- TankMaster PC workstations in network.
- Radio link between TankMaster PC workstation and Field Communication Unit.
- Local data display on the Data Acquisition Units or on the Remote Display Units.

Installation and commissioning of the TankRadar Rex System

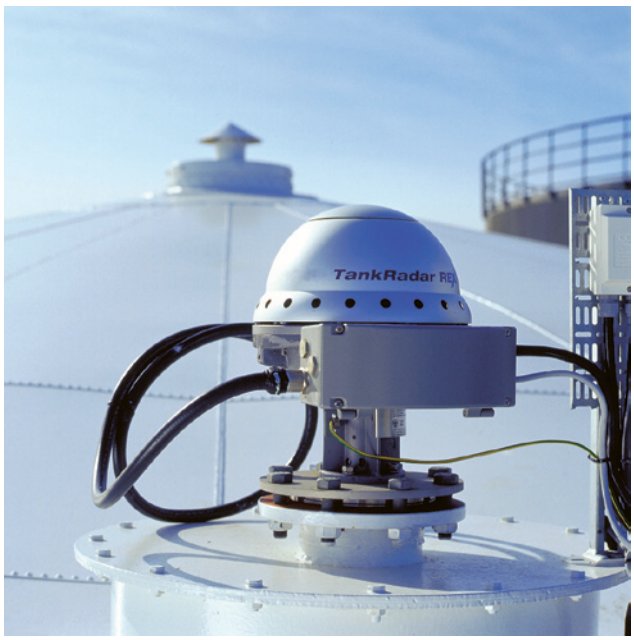
The TankRadar Rex system is easily installed by the customer or the customer's contractor. No special tools are required and all parts can be carried onto the tank roof.

Normally existing field cabling is used.

There are clear instructions in the Installation Manual and installation drawings. Installation can be done with the tanks in operation, except for pressurized tanks such as LPG tanks.

Commissioning is normally done by a trained engineer from our local representative, or in some cases by the customer.

The TankMaster WinSetup PC software is used to configure the system.



Rex gauges are installed using existing nozzles and manways.

Radar level gauging

TankRadar Rex gauges provide outstanding reliability using non-contact radar measurement with no moving parts and only the antenna inside the tank atmosphere.

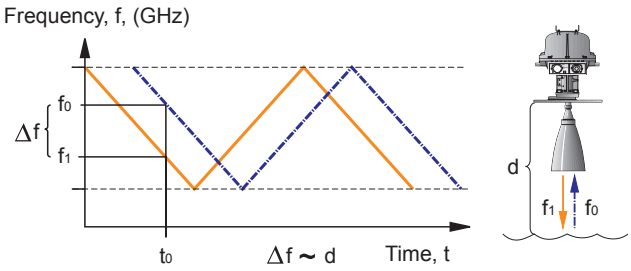
For radar level measurement, there are mainly two modulation techniques:

- Pulse method. Measures the time it takes for a pulse to travel to the surface and back. Pulse radar level gauges are mainly available or lower accuracy applications.
- Frequency Modulated Continuous Wave, FMCW. This method is used by high performance radar level gauges.

The FMCW method

The radar gauge transmits microwaves towards the surface of the liquid. The microwave signal has a continuously varying frequency around 10 GHz. When the signal has travelled down to the liquid surface and back to the antenna, it is mixed with the signal that is being transmitted at that moment. The frequency of the transmitted signal has changed slightly during the time it takes for the echo signal to travel down to the surface and back again. When mixing the transmitted and the received signal the result is a signal with a low frequency proportional to the distance to the surface. This signal provides a measured value with high accuracy. The method is called the FMCW-method (Frequency Modulated Continuous Wave).

This gauge is still operating and gauging accurately despite the heavy contamination. The parabolic antenna has for several months been exposed to blown bitumen heated to 160 °C (320 °F).



The FMCW-method is based on a radar sweep with varying frequency.

Accuracy enhancement

To enhance accuracy further, TankRadar Rex has some built-in unique features:

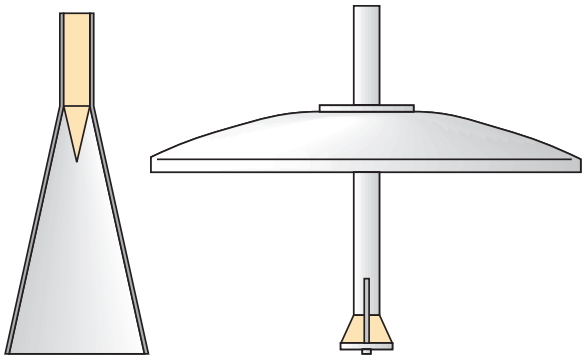
Temperature control
TankRadar Rex gauges are designed to operate in all climates. The gauge is continuously controlling the temperature of the electronics and keeps it constant. This is one of the reasons for the 65 years of mean time between failure (MTBF) for the gauge.

Digital reference
A radar gauge needs an internal reference to make the radar sweep absolutely linear. Each deviation from the linearity produces a corresponding inaccuracy. To achieve highest precision, TankRadar Rex uses a digital crystal oscillator. This gives the most stable reference that is available with today's technology.

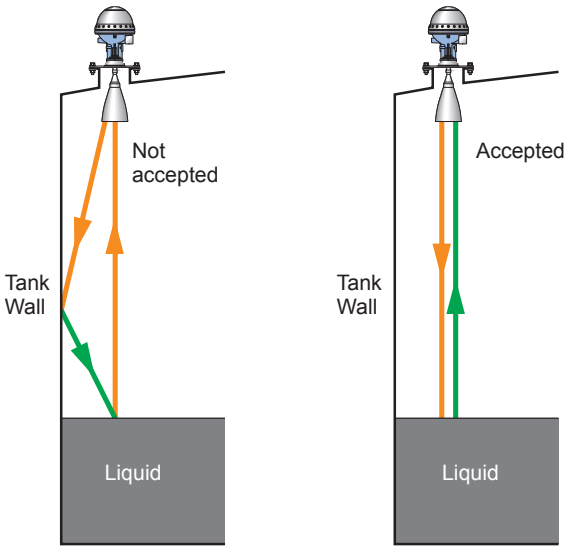
Drip-off means no condensation
If the antenna has an inclined polished PTFE-surface where the microwaves are emitted, it will be less susceptible to condensed water or product. The drops of condensation will not coat the active part of the antenna. In this way the radar signal will be less weakened resulting in higher accuracy and better reliability.

Measurement close to tank wall
A standard manway (or flange) is normally 0.3-1 m (1-3 feet) from the tank wall. Both the RTG 3920 Horn Antenna Gauge and the RTG 3930 Parabolic Antenna Gauge are specially designed to be mounted close to the wall.

The RTG 3920 Horn Antenna Gauge radar signal is polarized so that the direct reflection from the liquid surface is the only detectable reflection. Any wall disturbance will be blanked out. The RTG 3930 Parabolic Antenna has a narrow radar beam due to the large 20-inch antenna diameter resulting in a small and uncritical wall echo.

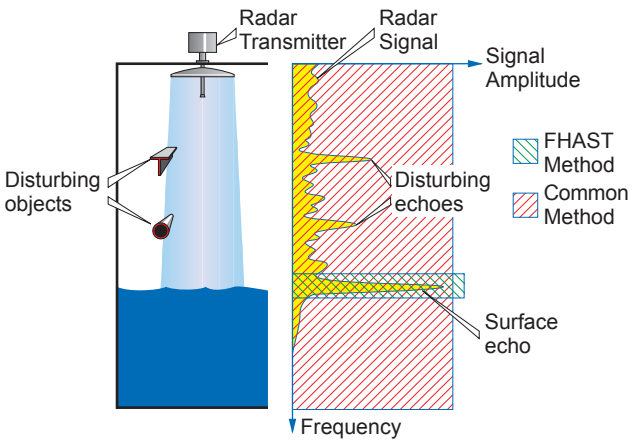


Antenna design with no horizontal surfaces according to the American Petroleum Institute Standard (API ch. 3.1B).



Gauges emitting microwaves with circular polarization can be installed closer to the tank wall.

Patented method for detecting the surface echo
TankRadar Rex uses a patented method for detecting the surface echo. The measured signal passes through a digital filter. First, one filter removes any echoes smaller than a threshold value. Then a narrow filter “window” is placed around the frequency corresponding to the surface echo. The remaining frequency is compared with the frequency calculated in the previous radar sweep, resulting in a very accurate measurement. This method uses the calculating power of the processor very efficiently and focuses on accuracy as well as fast and reliable results.



The FHAST™ filter limits the region around the liquid surface to be analyzed, resulting in a much more efficient signal processing.

No risk to be exposed to the micro-waves from the TankRadar Rex antenna

There are no health hazards from the TankRadar microwave output. As the emitted power from each transmitter is very low, there is no health hazard even when you are very close to the antenna. A few figures will illustrate this:
most international standards state that a power density of up to 1 mW/cm^2 is considered safe for continuous human exposure. The power density close to the antenna is 0.001 mW/cm^2 , and further down in the tank it is much lower. The transmitted microwave power is less than 1 mW. As a comparison, the normal sunshine a person is exposed to a sunny day corresponds to a power density of 100-150 mW/cm^2.

Lightning Protection

Lightning strikes can induce very high voltages in tank farm field cables. The TankRadar Rex system has been designed to minimize the risk of lightning damage to the equipment.

- Every node of the system is galvanically isolated on both the mains supply and the TRL/2 bus.
- Standard protection components and filters are able to handle fast transients.
- Multiple varistors (fast transient protection) and gas tube arrestors (surge protection) inside the gauge protect the electronics from over-voltages.
  Since any sparking will occur inside the flameproof enclosure, the tank is also protected from explosion hazard.
- Mains supply is protected by fuses.

SIL 2 Safety Functions

The Rosemount TankRadar Rex (RTG 3900 Series) has been assessed by third party and considered suitable for use in SIL 2 safety functions according to IEC 61508/61511.

The decision on the usage of proven-in-use devices, however, is always with the end-user.

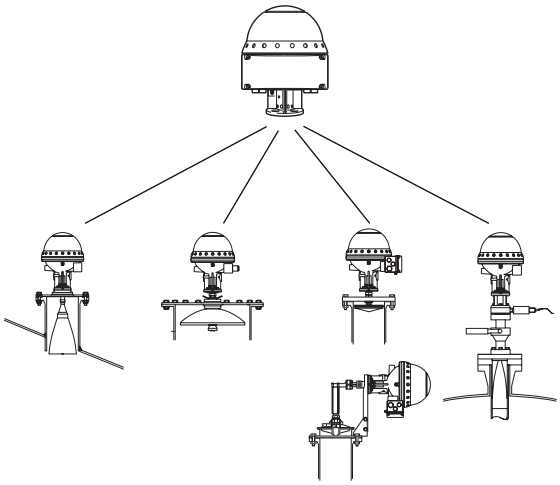
The safety function is based on the relay outputs. One relay, or a combination of two, can be used for overfill or dry run protection.

Radar Tank Gauges

There are five types of RTG 3900 Series Radar Tank Gauges to fit any storage tank:

- **Horn Antenna Gauge, RTG 3920**, for fixed roof installation without still-pipe.
- **Parabolic Antenna Gauge, RTG 3930**, for installation without still-pipe, for general use and in demanding environments.
- **Still-pipe Array Antenna Gauge, RTG 3950**, for measurement in existing still-pipes.
- **LPG/LNG Gauge, RTG 3960**, for liquiefied gas, LPG and LNG.

The Radar Tank Gauge (RTG) measures the distance to the surface of the product in the tank. Using tank distances stored locally in the memory of the gauge, it calculates the level of the liquid's surface. The level is communicated on the digital TRL/2 field bus to the Field Communication Units and to the PC workstations or other host computers.



The RTG 3900 Transmitter Head with different antennas.

Transmitter Head

The radar gauges are built up by the Transmitter Head (TH) and the antenna. The same Transmitter Head is used on all types of Rex tank gauges minimizing spare parts requirements. It is freely interchangeable between different gauges, regardless of antenna type. The Transmitter Head weight is only 8 kg (18 lbs).

The enclosure of the Transmitter Head is a rugged air and watertight protection against salt spray atmosphere in coastal areas.

Transmitter Head Electronics

The Transmitter Head Electronics (THE) is a separate unit located inside the safety enclosure of the Transmitter Head. It is easily exchangeable and not in contact with the tank atmosphere. The THE includes the microwave unit, circuit boards for signal processing, data communication, power supply and transient protection.

The unit contains no analog reference lines that can cause drift by age or temperature changes. It uses a digitally synthesized feedback channel from the microwave unit as a reference for the measurement. The Rex gauge requires no recalibration, not even after the THE has been exchanged.

Transmitter Head with optional junction box for deliveries according to CENELEC standards.

The following circuit boards are included in the THE:

Signal Processing Card (SPC)
The SPC card includes a high performance signal processor plus memories for tank specific data set via remote programming.

Analog Processing Card (APC)
The APC card is used for filtering and multiplexing of analog input signals. Keeping the analog circuitry on a separate card improves measuring accuracy by giving a high signal to noise ratio.

Transmitter Interface Card (TIC)
The Transmitter Interface Card (TIC) is required for intrinsically safe inputs. The TIC card includes:

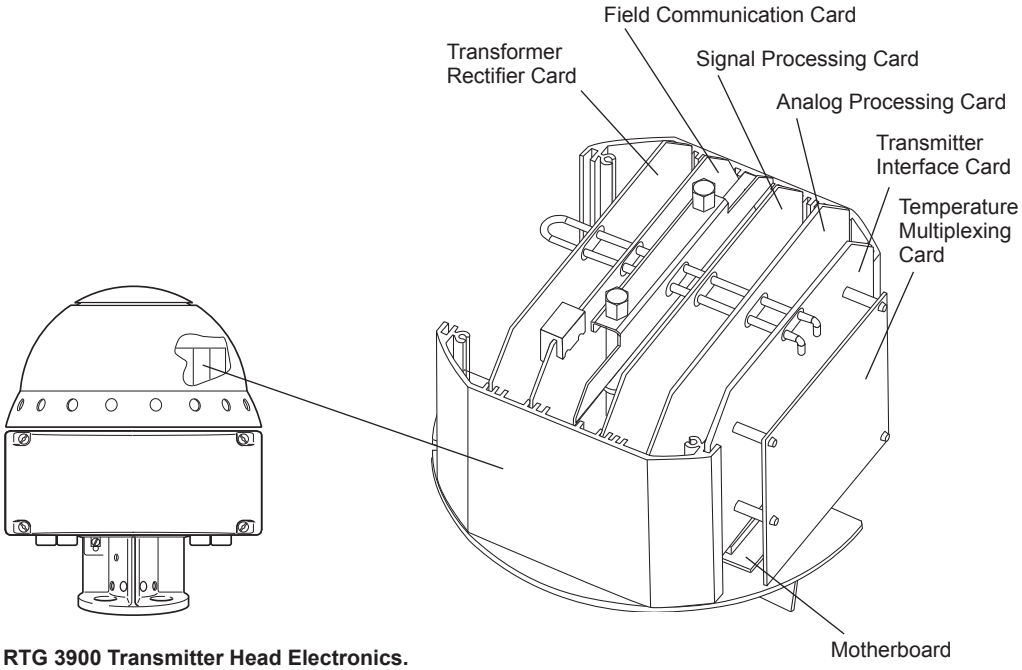
- Two supply zener barriers and two return barriers for 4-20 mA current loops.
- One supply zener barrier for a Slave Data Acquisition Unit or a Remote Display Unit
- Signal/supply connection for optional Temperature Multiplexer Card (TMC).

Temperature Multiplexer Card (TMC)
The Temperature Multiplexer Card (TMC) is used to connect up to 6 temperature sensors directly to the RTG.

Relay Output Card (ROC)
The Relay Output Card (ROC) includes two relays. It allows controlling external devices such as valves, pumps, heating coils, overfill protection according to TÜV etc.

Field Communication Card (FCC)
The FCC card handles communication with external devices. There are different versions of the FCC card allowing the use of various types of communication protocols and also emulation of gauges from other vendors.

Metrological Seal (option)
An optional metrological seal prevents unauthorized changes in the database. Two versions are available; One external seal verifiable from the outside, and one internal seal located inside the Transmitter Head. The metrological seal is a requirement from fiscal authorities in some countries.



RTG 3900 Transmitter Head Electronics.

Technical Data for the Transmitter Head	
Instrument accuracy:	RTG 3900 ± 0.5 mm ± (5/256 in.) RTG 3900 L ± 3 mm ± (1/8 in.)
Ambient operating temperature:	-40 °C to +70 °C (-40 °F to +158 °F)
Hazardous locations certifications:	II 1/2 G EEx d[ia] IIB T6 (T_{amb} -40 °C to +70 °C) according to ATEX directive (EN 50014, EN 50018, EN 50020, EN 50284 Europe) and Class 1, Div I, Groups C and D according to (UL 1203, UL 913, UL 508 USA). IECEx d IIB T6 (T_{amb} -40 °C to +60 °C). See also the list on page 46, "Certificates".
Ingress protection:	IP 66 & 67
Housing Material:	Anodized Aluminium
Power Supply:	100-240 VAC, 50-60 Hz, average 15 W (max. 80 W at gauge power up in temperatures below freezing point) 34-70 VAC (option) 20-28 VDC, max 30 W (option) 48-99 VDC (option)
Analog outputs:	One output 4-20 mA passive or active (non-intrinsically safe)
Analog inputs:	alt 1) One or two 4-20 mA alt 2) One 4-20 mA input plus one digital HART input. (The RTG is HART master. Each RTG can have maximum 3 HART slaves).
Relay outputs:	Max 2 relays, only 1 output available if analog outputs are included. See also under "Field bus (options)" and "Other vendor's communication protocols" below.
Field bus (standard):	1) TRL/2 Bus (FSK, half duplex, two wires, galvanically isolated, 4800 Baud, Modbus based) 2) RS485 (Modbus based)
Field bus (options):	1) Profibus® DP 2) Tiway® *(Only one relay available, analog out not available)* 3) FOUNDATION™ fieldbus *(Non IS: Only one relay available, analog out not available. IS: only one analog input available)*
Other vendors' communication protocols:	1) Enraf® *(Requires special Field Bus Modem, EBM)* 2) Varec® *(Only one relay available, analog output not available)* 3) L&J® *(Only one relay available, analog output not available)* 4) Whessoe® *(Only one relay available, analog output not available)* 5) GPE® *(Only one relay available, analog output not available)* 6) Sakura® *(Only one relay available, analog output not available)* 7) Tokyo Keiso® (TIC) *(Only one relay available, analog output not available)*
Temperature inputs:	Up to 6 Pt 100 Resistance Temperature Detector (RTD) inputs with common return or 3 RTD inputs with individual wiring, directly in TH. Up to 14 RTD inputs via separate Data Acquisition Unit, see page 26.
Temperature conversion accuracy:	± 0.1 °C for -50 °C to +250 °C (-58 °F to +482 °F) Note! Temperature range for PTB approval is -20 °C to +90 °C (-4 °F to +194 °F)
Field data display:	In separate DAU (page 26) or RDU (page 27).

Cable Connections to the Transmitter Head
The Transmitter Head is either delivered with an integrated junction box (JBi) for cable connections, or with two cable outlets only. The JBi includes two connection terminals; one for power, field bus and relays, and one for intrinsically safe connections from temperature, pressure and water bottom sensors, Data Acquisition Unit, Remote Display Unit etc.

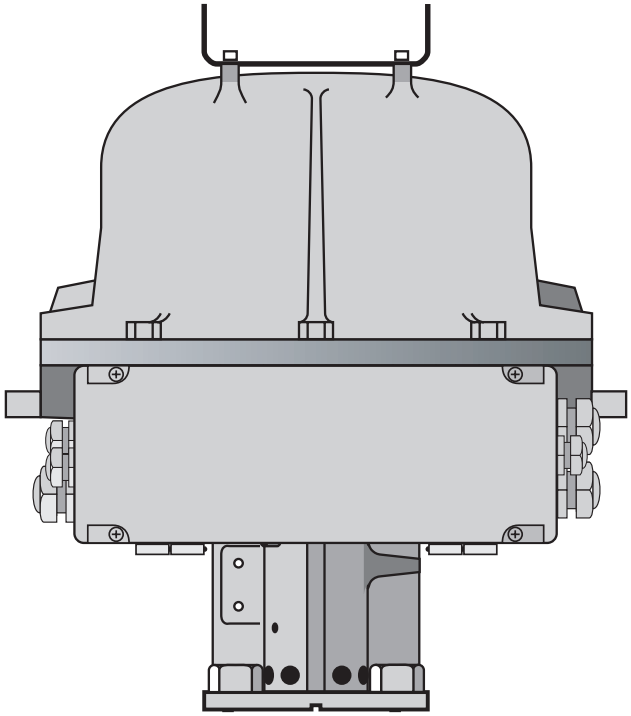
If the JBi is **not** included, the gauge is delivered with two separate cable outlets as follows:

For power and field bus:
Number of wires: 8
Length: 2.5 m (8 ft)
[Optional cable length 20 m (50 ft)]

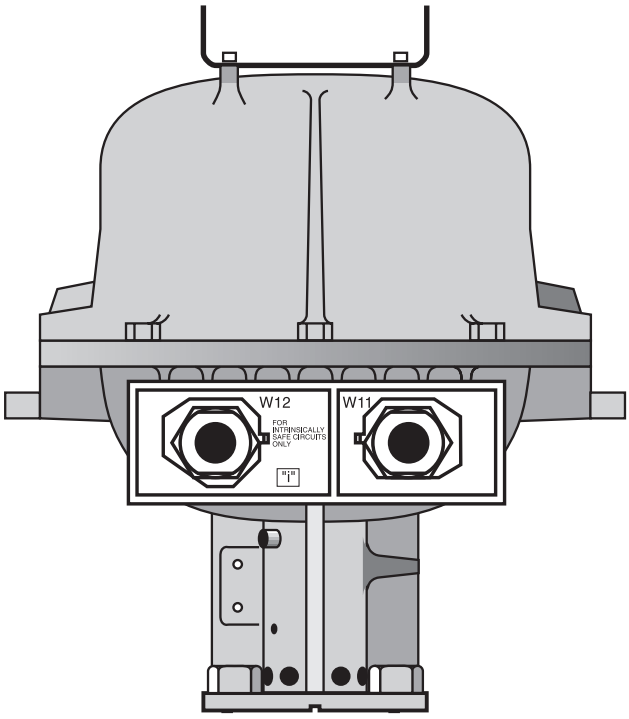
For IS connections such as temperature:
Number of wires: 8 or 15
Length: 2.5 m (8 ft)
[Optional cable length is 20 m (50 ft)]

The TH version with cables and no JBi is always delivered with shipments to the USA (UL certification).
The field bus uses a 2-core twisted and shielded standard instrument cable for distances up to 4 km (2.5 miles).

For more details about installation, see separate installation manual and installation drawings.

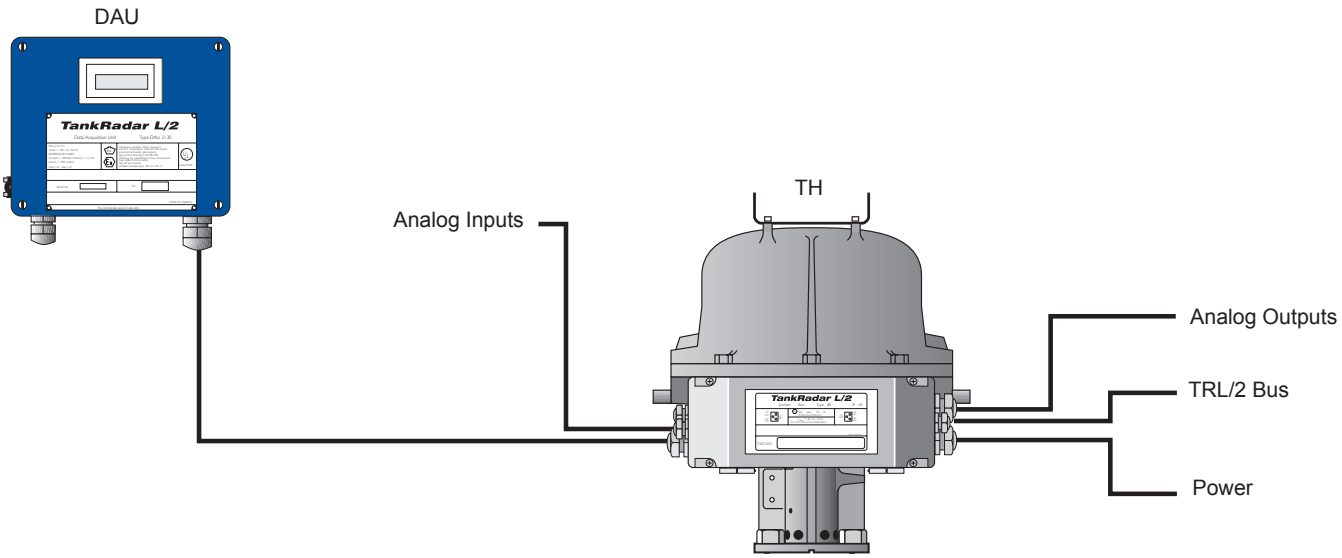


Transmitter Head with JBi.



Transmitter Head with cable outlets and no JBi.

Technical data for integrated junction box (JBi)	
For data on available separate junction boxes, see page 33.	
Hazardous locations certifications:	Increased safety according to EExe IIB T4. There is one EExe side for power and bus cables (W11 wire terminal), and one EExi side for intrinsically safe connections (W12 wire terminal).
Ingress Protection:	IP65
Material:	Cast aluminium coated with grey polyester
Temperature range:	-40 °C to +70 °C (-40 °F to +158 °F)
Cable inlets EExe side (W11):	Standard: 2 pcs M25, 1 pc M20 Option: 2 pcs ¾-in. with NPT thread and 1 pc ½-in. with NPT thread.
Wire terminals EExe side (W11):	8 terminals. (For power and Field Bus)
Cable inlets EExi side IS cabling (W12):	Standard: 1 pc M25, 2 pcs M20 Option: 1 pc ¾-in. with NPT thread, 2 pcs ½-in. with NPT thread.
Wire terminals EExi side (W12):	15 terminals. (For intrinsically safe cables, e.g. to a DAU, temp sensors etc.)
Cable glands:	All cable glands must be of EExe type. Each cable inlet is, as standard, sealed with an Ex approved metal blind plug at delivery.



Typical TH connections.

Horn Antenna Gauge RTG 3920

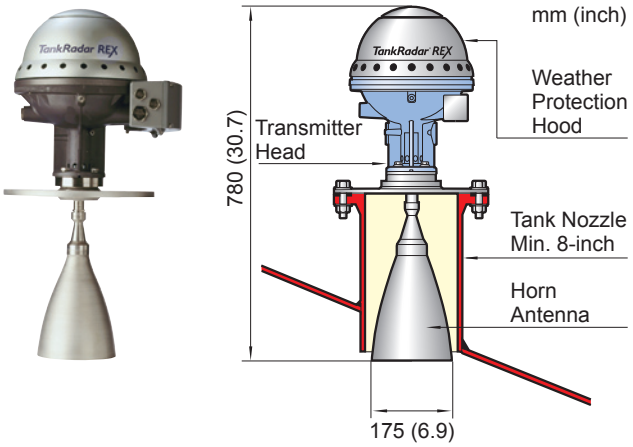
The Horn Antenna Gauge is designed for easy mounting on 200 mm (8-inch) or larger nozzles on tanks with fixed roofs.

The RTG 3920 gauge measures on a variety of oil products and chemicals except for asphalt and similar products where the Parabolic Antenna Gauge RTG 3930 is recommended.

The Horn Antenna Gauge is delivered with a flange for straight mounting or one for inclined mounting. The inclined flange is used when the gauge is mounted close to the tank wall and highest accuracy is required. Otherwise the straight flange can be used.

The entire horn antenna is inside the tank and has almost the same temperature as the tank atmosphere preventing condensation on the inside of the antenna.

Installation is normally made without taking the tank out of operation.



RTG 3920 Horn Antenna Gauge.

Technical Data for RTG 3920	
See also technical data for the Transmitter Head.	
Instrument accuracy:	RTG 3920 ± 0.5 mm ± (5/256 in.) RTG 3920 L ± 3 mm ± (1/8 in.)
Operating temperature in tank:	Max. +230 °C (+445 °F)
Measuring range (standard):	0.8 to 20 m (2.6 to 65 ft) below flange
Measuring range (option):	0.3 to 30 m (1 to 100 ft) below flange with reduced accuracy
Pressure:	-0.2 to 2 bar (-2.9 to 29 psig)
Total weight:	Appr. 20 kg (44 lbs)
Material exposed to tank atmosphere:	Antenna: Acid proof steel type EN 1.4436 (AISI 316) Sealing: PTFE O-ring: FPM (Viton®)
Antenna dimension:	175 mm (7 in.)
Nozzle diameter:	Minimum 200 mm (8 in.)
Mounting flange:	8-in. ANSI B 16.5 150 lbs/DN 200 PN 10 DIN 2632/SS2032 Monting flange can be horizontal or 4° inclined for mounting close to tank wall (Other flanges available on request).
Field data display:	In separate DAU (page 26) or RDU (page 27)

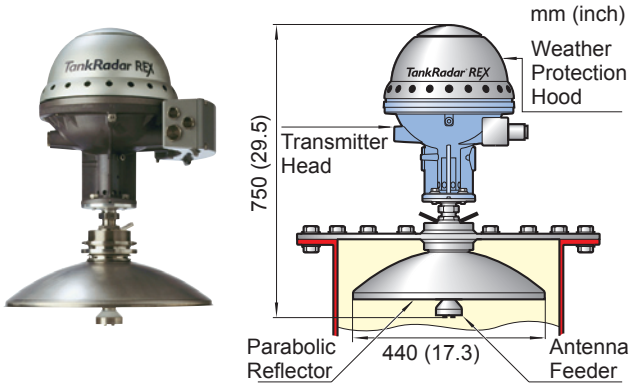
Parabolic Antenna Gauge RTG 3930

The RTG 3930 gauge is designed for mounting on tanks with fixed roofs. It measures levels of products ranging from clean products to very difficult ones like bitumen/asphalt. The design of the parabolic antenna gives extreme tolerance against sticky and condensing products.

The large antenna diameter provides high antenna gain and a high signal to noise ratio. The Parabolic Antenna Gauge can be mounted on existing manhole covers. The standard parabolic reflector has a diameter of 440 mm (17 inch) and it fits onto, for example, a 20 inch manway. For easy access in extremely dirty applications, the gauge can be mounted on a manhole cover with hinges.

The Parabolic Antenna Gauge can also be used on tanks with floating roofs. The RTG is then mounted at the tank top and measures the distance down to a target plate on the floating roof.

Installation is normally made without taking the tank out of operation.



RTG 3930 Parabolic Antenna Gauge.

Technical Data for RTG 3930	
See also technical data for the Transmitter Head.	
Instrument accuracy:	RTG 3930 ± 0.5 mm ± (5/256 in.) RTG 3930 L ± 3 mm ± (1/8 in.)
Operating temperature in tank:	Max. +230 °C (+445 °F)
Measuring range:	0.8 to 40 m (2.6 to 130 ft) below flange. For longer measuring range, please consult your Rosemount Tank Gauging representative.
Pressure:	Clamped: -0.2 to 0.2 bar (-2.9 to 2.9 psig) Welded: -0.2 to 10 bar (-2.9 to 145 psig)
Total weight:	Appr. 25 kg (55 lbs)
Material exposed to tank atmosphere:	Antenna: Acid proof steel type EN 1.4436 (AISI 316) Sealing: PTFE O-ring: FPM (Viton®)
Antenna dimension:	440 mm (17 inch)
Manway size:	Min. 20-in
Tank connection:	Gauge is clamped in a 96 mm (3.78 inch) diameter hole, or welded in a 117 mm (4.61 inch) diameter hole
Field data display:	In separate DAU (page 26) or RDU (page 27)

Still-Pipe Array Antenna Gauge RTG 3950

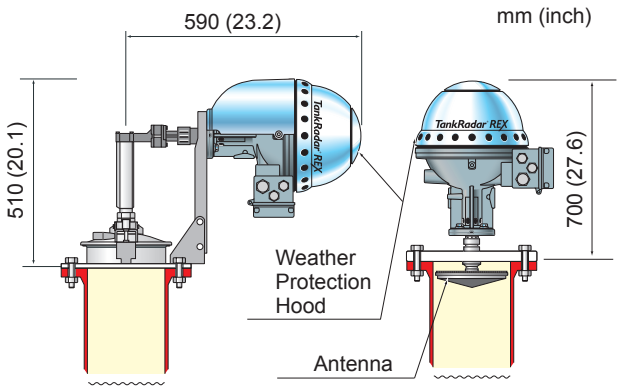
RTG 3950 with its small-sized array antenna is made for mounting on existing still-pipes. Typical applications are crude oil tanks with floating roofs and gasoline/product tanks with or without inner floating roofs.

To get custody transfer accuracy, the gauge uses the Low Loss Mode technology, invented for the TankRadar® products, to transmit the radar waves in the center of the pipe. This virtually eliminates degradation of the accuracy due to rust and product deposits inside the pipe.

RTG 3950 is available for 5-, 6-, 8-, 10- and 12-inch pipes.

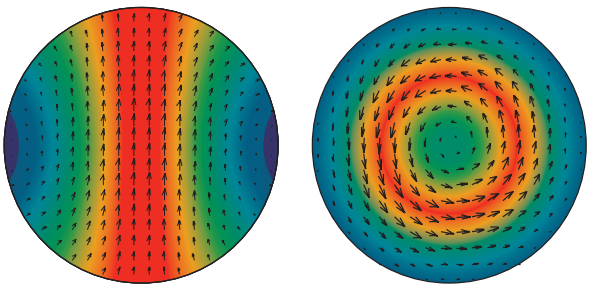
There are two versions of RTG 3950; fixed and inclined. The inclined version has a hinged hatch, enabling full pipe size product sampling or verification hand-dips.

Installation is normally made without taking the tank out of operation.



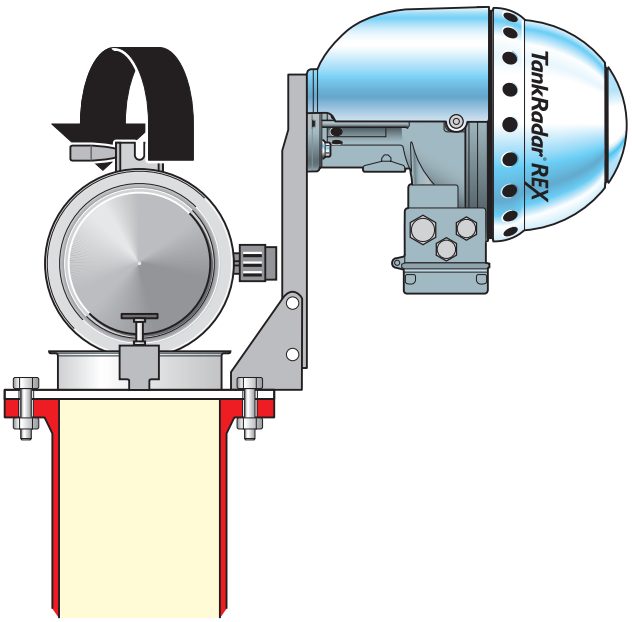
RTG 3950 Still-Pipe Array Antenna Gauge, inclined and fixed versions.

Pipe seen from above



H_{11} is the normal radar mode of a circular waveguide.

Low Loss Mode: Very low losses from rust or deposits.



Removable Waveguide Unit allows hand dips and sampling.

Technical Data for RTG 3950	
See also technical data for the Transmitter Head.	
Instrument accuracy:	RTG 3950 ± 0.5 mm ± (5/256 in.) RTG 3950 L ± 3 mm ± (1/8 in.)
Operating temperature in tank:	Max. -40 °C to +120 °C (-40 °F to +248 °F)
Measuring range:	0.8 to 40 m (2.6 to 130 ft) from antenna end. For longer measuring range, please consult your Rosemount Tank Gauging representative.
Pressure (two versions available):	**Fixed version:** -0.2 to 2 bar (-2.9 to 29 psig) at 20 °C **Inclined version:** 5 to 8 in. pipes, -0.2 to 0.5 bar (-2.9 to 7.2 psig). 10 and 12 in. pipes, -0.2 to 0.25 bar (-2.9 to 3.6 psig)
Total weight:	21.5-32 kg for fixed version and 28.5-41.5 kg for inclined version, depending on dimension
Material exposed to tank atmosphere:	Antenna: Polyphenylensulfid (PPS) Sealing: PTFE O-ring: Fluorosilicone Flange: Acid Proof Steel EN 1.4404 (AISI 316L)
Still-pipe dimensions:	5-, 6-, 8-, 10- or 12 in.
Field data display:	In separate DAU (page 26) or RDU (page 27)

LPG/LNG Gauge RTG 3960

The RTG 3960 gauge is designed for level measurement of liquefied gas in LPG or LNG tanks.

A still-pipe enables the gauge to have a sufficiently strong echo even under surface boiling conditions.

The radar signals are transmitted inside the still pipe.

The pressure sealing is a quartz/ceramic window approved for use in pressure vessels.

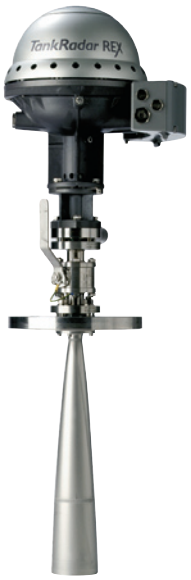
As an option the gauge is equipped with a fire-proof ball valve and a vapor space pressure sensor. The pressure sensor is required for highest accuracy.

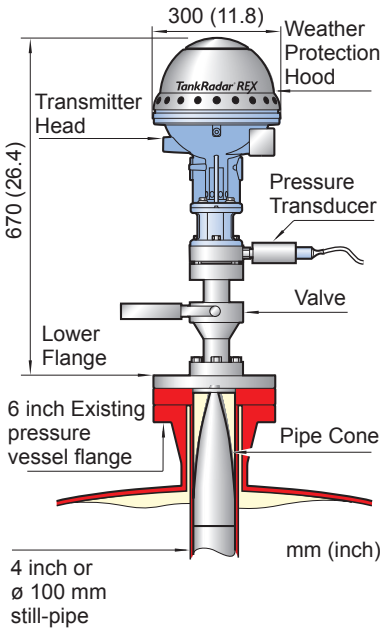
The installation flange of the LPG/LNG Gauge is available in three different versions; 6-in. 150 psi, 6-in. 300 psi or 6-in. 600 psi.

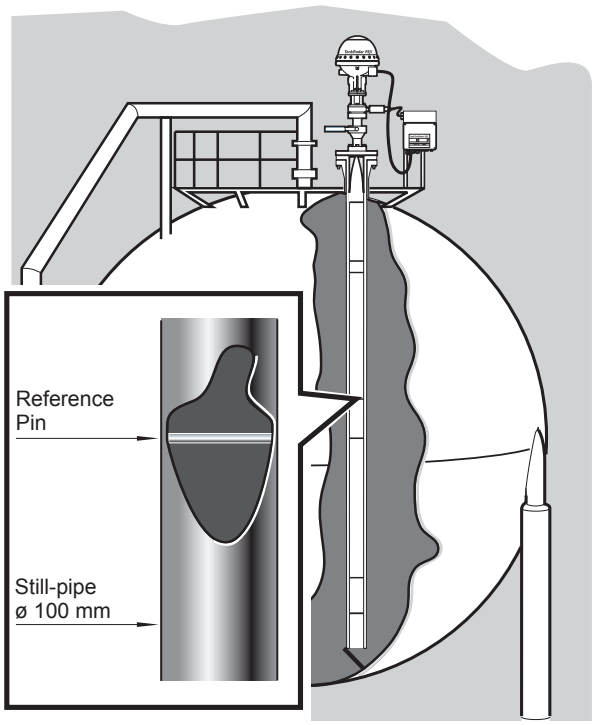
A patented reference device function enables measurement verification with the tank in operation.

A reference pin mounted in a still-pipe hole, and a deflection plate with a reflection ring at the lower pipe end provides measured distance values which are compared with stored positions.

Installation is made with the pressurized tank taken out of operation.







The reference pin mounted inside the 4-inch still-pipe and a bottom reflection ring enable the measurement to be checked during operation.

Technical Data for RTG 3960	
See also technical data for the Transmitter Head.	
Instrument accuracy:	RTG 3960 ± 0.5 mm ± (5/256 in.) RTG 3960 L ± 3 mm ± (1/8 in.)
Operating temperature at ball valve:	-55 °C to 90 °C (-67 °F to 194 °F)
Operating temperature in tank:	-170 °C to 90 °C (-274 °F to 194 °F)
Measuring range:	0.5 m to 60 m (1.6 ft to 200 ft) from cone end. For longer measuring range, please consult your Rosemount Tank Gauging representative.
Maximum pressure:	Up to 25 bar (365 psig). (Note! Flanges may have higher pressure rating than 25 bar, but maximum tank pressure is still 25 bar).
Pressure rating:	10 bar/150 psi 20 bar/300 psi 40 bar/600 psi
Pressure sensor (option):	Druck PTX 621
Flange:	6-in.
Still-pipe dimension alternatives:	4-in. sch. 10 or sch 40 100 mm (99 mm inner diameter).
Total weight:	38 kg (84 lbs) for 6-in. 150 psi 48 kg (106 lbs) for 6-in. 300 psi
Material exposed to tank atmosphere:	Antenna: Acid proof steel type EN 1.4436 (AISI 316) Sealing: Quartz
Ball valve sealing kit (option):	20 bar or 60 bar (290 psi or 870 psi), the higher pressure for 600 psi flange only
Field data display:	In separate DAU (page 26) or RDU (page 27)

Temperature measurement

Product temperature is an important parameter for accurate custody transfer and inventory measurement in liquid bulk storage tanks. High quality Multiple Spot Thermometers (MST) can be included in the Rex system delivery as an essential part.

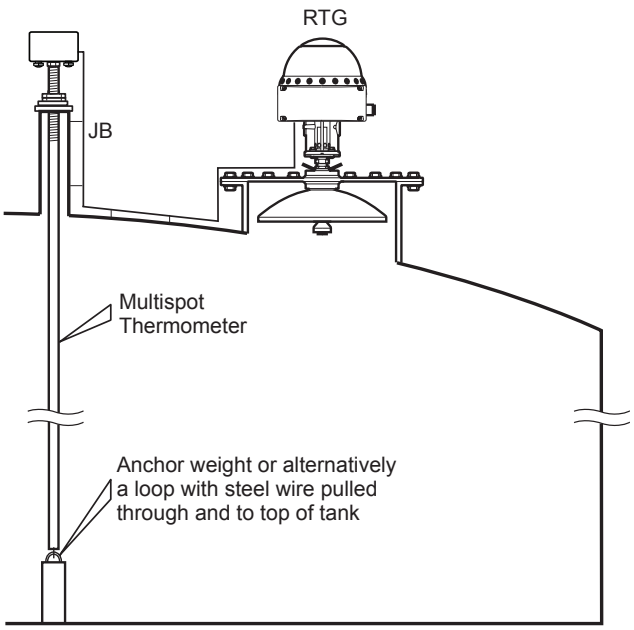
The Multiple Spot Thermometer (MST) measures the temperature with a number of Pt 100 spot elements placed at different heights to provide a tank temperature profile and an average temperature. Only the elements that are fully immersed are used to determine the product temperature. The spot elements are placed in a flexible gas tight protection tube made from convoluted stainless steel. A flange can be attached to a top fitting and the tube can be anchored to the bottom.

API chapter 7 recommends minimum one element per 10 feet (3 m) tank height for custody transfer applications.

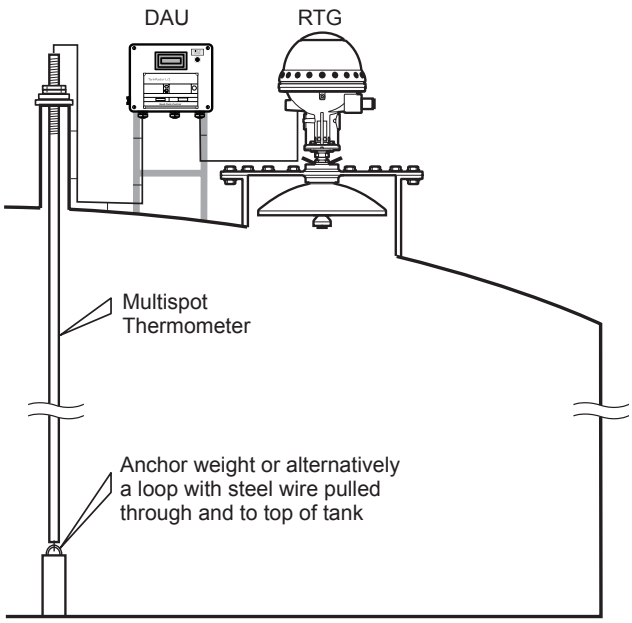
The Multiple Spot Thermometer is easy to install, even if the tank is in service. In pressurized tanks the MST can be installed in a closed thermowell so that it can be removed for service or inspection while the tank is in operation. For LPG tanks single spot temperatures sensors in thermowells are used. Temperature sensors can be connected in two ways to the RTG:

- Directly into the RTG with common return connection (up to six temperature elements)
- Via the DAU (up to 14 temperature elements)

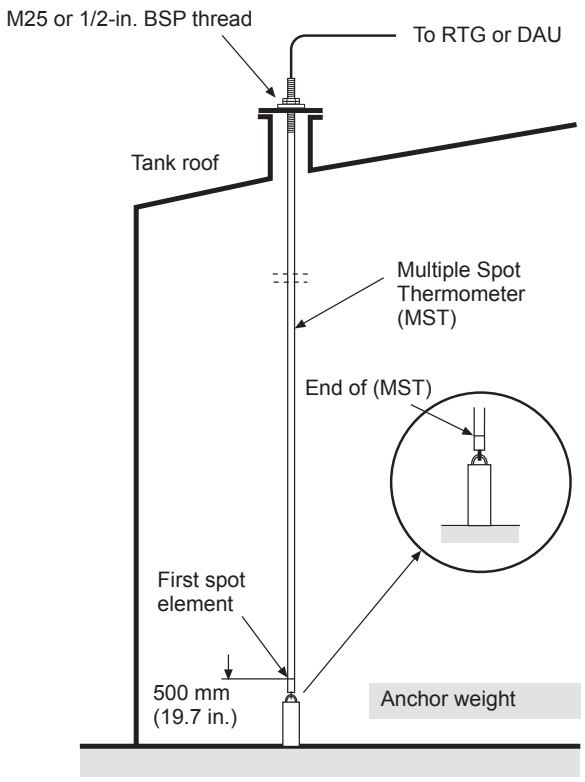
A water level sensor can be integrated in the MST, see page 25. It is also possible to have an integrated junction box (see picture below).



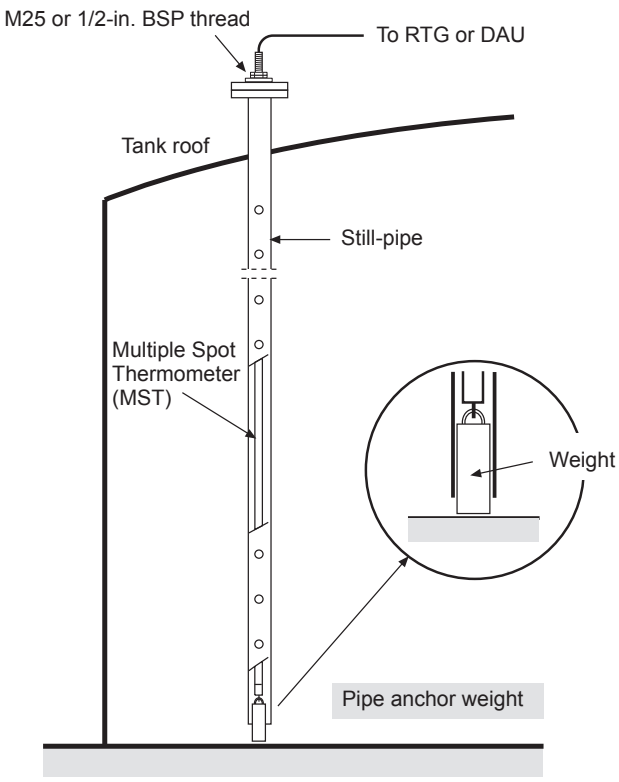
Up to 6 temperature elements can be connected directly to the radar gauge.



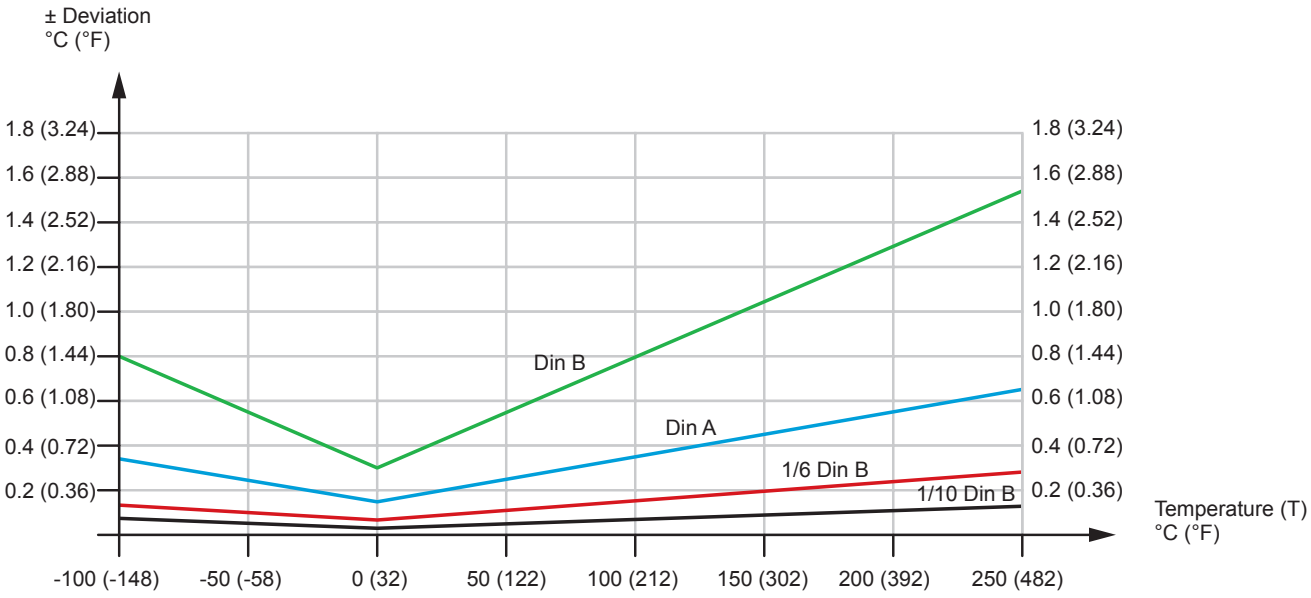
When the number of temperature elements is above 6 they are connected via a Data Acquisition Unit. Maximum 14 temperature elements can be connected.



Alternative 1: Anchoring weight



Alternative 2: Still-pipe



For many users DIN Class A and DIN Class B temperature accuracy is not sufficient. Temperature sensor elements are therefore available with 1/6 DIN B as standard, and 1/10 as an option.

DIN A= ± (0.15 + 0.002 * |T|)
DIN B= ± (0.30 + 0.005 * |T|)
1/6 DIN B= ± (0.30 + 0.005 * |T|) * 1/6
1/10 DIN B= ± (0.30 + 0.005 * |T|) * 1/10

Technical Data for Multispot Thermometer	
Elements type:	Pt 100 spot elements according to EN 60751
Accuracy:	1/6 DIN Class B (standard), 1/10 DIN Class B (option). See diagram on previous page
Overall temp range (standard):	-50 °C to 120 °C (-58 °F to 248 °F)
Overall temp range (optional):	-20 °C to 250 °C (-4 °F to 482 °F) -170 °C to 100 °C (-274 °F to 212 °F)
Number of elements:	6 elements per MST as standard. Max. 14 elements for each MST
Overall length:	0.95-70 m (3.1-230 ft)
Sheath diameter:	¾-in. (standard), 1-in. (always with WLS)
Top fitting:	Steel pipe with 1/2-in. BSP thread or M25 x 1.5. Thread length 253 mm (10.0 in.)
Tank opening:	Min. ø 2-in. (50.8 mm)
Outer Material:	Stainless steel, AISI 316
Flange (option):	1½ to 4 in.
Lead wire length:	3 m (9.8 ft). Longer wires optional, max 10 m (32.8 ft).
No of wires:	3 independent wires per element or 1 wire per element plus 2 common return wires
Bottom weight:	2.5-15 kg (5.5-33 lbs). 2.5-4 kg (5.5-9 lbs) for still-pipe installation.
Connection to Rex system:	Max. 14 elements via DAU, or max 6 elements with common return directly to Rex Gauge (max. 3 elements with independent wires)
Designed according to:	IEC 751 and ATEX Directive 94/9/EC
Technical Data for Single Spot Temperature Sensor – LPG tanks	
Element type:	Pt100, 1/6 DIN Class B or optional 1/10 DIN Class B, 3 wire
Temperature range (standard):	-50 °C to 260 °C (-58 °F to 500 °F)
Temperature range (optional):	-50 °C to 400 °C (-58 °F to 752 °F)
Sheath:	8 mm (0.31 in.), 9 mm (0.35 in.) or 11 mm (0.43 in.) outer diameter
Sheath material:	Stainless steel AISI 316TI
Mounting thread:	½-in. NPT or BSP thread
Length (standard):	500 mm (20 in.)
Thermowell:	16 mm (0.63 in.) outer diameter as standard
Thermowell material:	Stainless steel AISI 316TI
Designed according to:	IEC 751 and ATEX Directive 94/9/EC

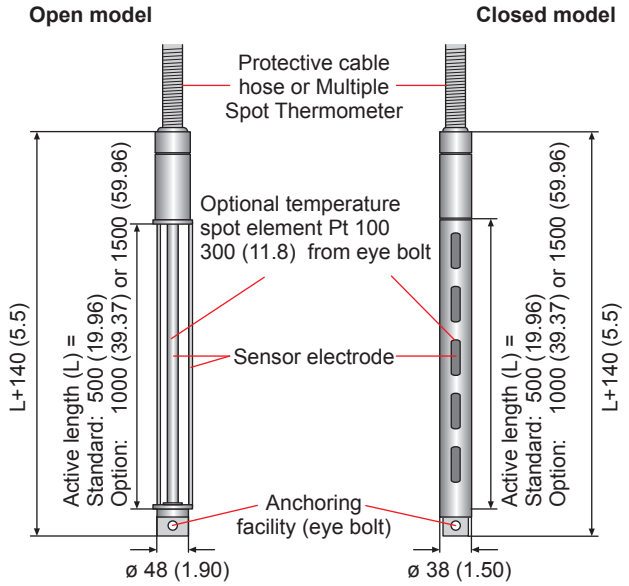
Water interface measurement

The capacitive Water Level Sensor (WLS) continuously measures free water level below the oil surface and provides input for on-line net inventory. The sensor is integrated with the Multiple Spot Thermometer MST, see page 22. It has a heavy duty design with no moving parts. The WLS outputs an analog 4-20 mA signal, which is connected directly to a radar gauge. There is a Pt100 temperature sensor inside the probe allowing temperature measurements at low levels. The WLS is welded to the MST to get a hermetic design. The open model WLS is suitable for crude oil applications and the closed model is suitable for lighter fuels such as diesel oil etc.

A junction box can be integrated with the WLS.

Offset calibration can be done via HART® communication.

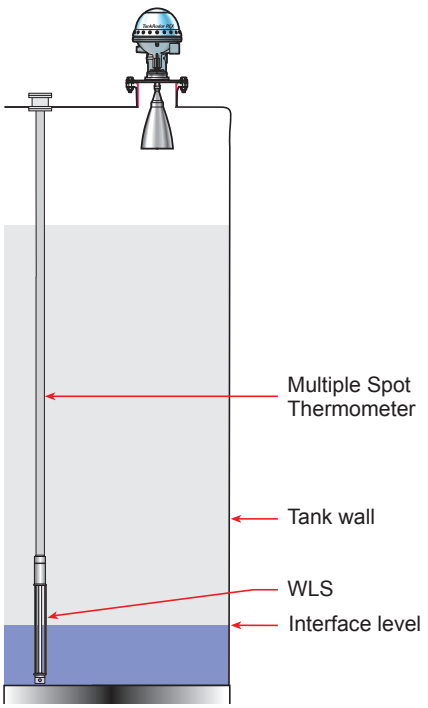
Technical Data for WLS	
Active measuring range:	500 mm (20 in.), 1000 mm (40 in.). Optional: 1500 mm (60 in.)
Output analog:	2-wire, 4 - 20 mA with I_{max} = 23 mA
Accuracy:	± 2 mm (0.08 in.) [500 mm active length] ± 4 mm (0.16 in.) [1000 mm active length] ± 6 mm (0.24 in.) [1500 mm active length]
Factory calibration:	Calibrated under conditions ε_r =2.3 (diesel) via 2 wire loop (Other calibrations on request)
Operating temperature:	0 - 120 °C (32 °F to 250 °F) [Max. temp. at mounting flange 80 °C (180 °F)]
Mechanical dimensions:	Connection thread M33x1.5 mm.
Length of WLS:	Active length + 140 mm (5.5 in.)
Outer diameter of WLS:	closed ø 38 mm (1.5 in.)
Outer diameter of WLS:	open ø 48 mm (1.9 in.)
Immersed materials:	AISI 316, FEP, PTFE and PEEK with 30% glass
Max. pressure:	6 bar (90 psig)
Ex approvals:	DEMKO 01 ATEX 131128X, CE 0539 ⟨Ex⟩ II 1 G, EEx ia IIB T4. UL approval pending
Open model:	Suitable for crude oil applications
Closed model:	Suitable for lighter fuels such as diesel oil.


Open model
Closed model
Protective cable hose or Multiple Spot Thermometer
Optional temperature spot element Pt 100 300 (11.8) from eye bolt
Sensor electrode
Anchoring facility (eye bolt)
L+140 (5.5)
Active length (L) = Standard: 500 (19.96) Option: 1000 (39.37) or 1500 (59.96)
ø 48 (1.90)
ø 38 (1.50)

mm (inch)

A typical application:

The WLS is installed together with an MST to be hung from the top of the tank.
The vertical position is chosen according to the actual bottom water range.
The WLS should be anchored to the tank bottom to ensure a fixed position in case of turbulence.



Anchoring weight can be mounted in the bottom eye bolt or above the WLS in which case the weight is hollow and fitted on the MST.

Data Acquisition Unit, DAU 2100

The Data Acquisition Unit (DAU 2100) is used together with an associated Radar Tank Gauge for local readout and for connection of temperature sensors.

A Multiple Spot Thermometer (MST) with up to 14 temperature elements can be connected to the DAU. The unit is powered from, and communicates through the Radar Tank Gauge to which it is connected. The DAU is intrinsically safe using zener barriers on the Transmitter Interface Card (TIC) in the Radar Tank Gauge.

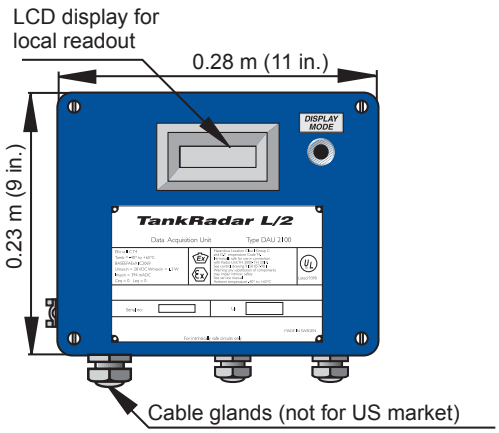
The weatherproof box houses a printed circuit board with a cable terminal for connection of the temperature sensors, as well as the power and communication cable. Cable inlet cable glands are located at the bottom of the box.

The DAU with Local Readout Display mounted at the foot of a tank.

Local Readout

The DAU can be equipped with a Readout Display showing level, temperature and other measured values. With the DAU placed at the foot of the tank, these values can be viewed at the tank without having to climb to the tank top.

If required, the DAU can also be placed at the tank top.


LCD display for local readout
0.28 m (11 in.)
0.23 m (9 in.)
DISPLAY MODE
TankRadar L/2
Data Acquisition Unit Type DAU 2100
Cable glands (not for US market)

DAU 2100.

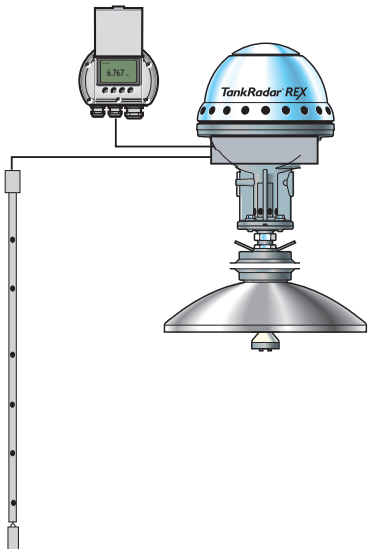
Technical Data for DAU 2100	
Ambient operating temperature:	-40 °C to 70 °C (-40 °F to+158 °F)
Number of sensor elements:	Max. 14 per DAU
Temperature ranges:	Range 1: -50 °C to 125 °C (-58 °F to 257 °F) Range 2: -50 °C to 300 °C (-58 °F to 572 °F) Range 3: -200 °C to +150 °C (-330 °F to 302 °F) Note! Temperature range for PTB approval is -20 °C to +90 °C (-4 °F to +194 °F)
Temperature resolution:	0.1 °C (0.18 °F)
Accuracy (excl. sensor):	±0.2 °C (±0.36 °F) [for -20 °C to 100 °C (-4 °F to 212 °F)] ±0.5 °C (±0.9 °F) [for other ranges]
Sensor elements:	Pt 100 single or multispot
Display (optional):	LCD with 6 digits
Available data on display:	Level, Ullage, Spot temperature, Average temperature, Level rate, Signal strength
Ingress protection:	IP 66 & 67
Explosion protection:	II 1G EEx ia IIB T4 (ATEX) and Class 1, Div I, Groups C and D (UL913 USA). See also the list on page 46, Certificates.
Power Supply:	Intrinsically safe supply from Radar Tank Gauge
Field bus:	Intrinsically safe local line from Radar Tank Gauge

Remote Display Unit, RDU 40

The Remote Display Unit (RDU 40) is a robust display unit for outdoor use in hazardous area. If the number of temperature elements per tank is 6 or less, the RDU 40 is the most cost-effective solution for field display. In this case the temperature elements can be connected directly to the TankRadar gauge (RTG) without using a Data Acquisition Unit (DAU). The display functions are software controlled by the connected TankRadar gauge. It is easy to work with via the 4-key display keyboard. Each screen view can display 7 text lines with 16 characters per line.

The RDU 40 is connected by a 3-wire cable up to 100 m (330 ft) from the RTG. Up to two units can be connected to one TankRadar Rex gauge. It displays calculated data, such as level, average temperature, volume, signal strength, etc. The data can be displayed in lists or as single values in very easily readable 25 mm (1 inch) solid fonts. The operator can set up a user-defined window where the most useful information is presented. This window will be shown as the default view. The RDU 40 can view up to six spot temperature elements connected to a TankRadar Rex gauge.

The rugged design of the RDU 40 makes it withstand many years of outdoor use under harsh environmental conditions.



The RDU is connected to The TankRadar Rex gauge.

Technical Data for RDU 40		
View/Software:	Available data:	Level, Ullage, Spot temperature , Average temperature, Volume, Level rate, Signal strength
Electrical:	Display type:	Graphic LCD display 128 x 64 pixels
	Ambient temperature:	-20 °C to 55 °C (-4 °F to 130 °F)
	Hazardous locations certifications:	II 2 G EEx ib IIC T4 (ATEX)
	FM:	Class 1 Div 1 Group A, B, C, D
	Max cable length:	100 m (328 ft) (total length if two units are connected to the same gauge)
Mechanical:	Material housing:	Die cast aluminium
	Dimensions (widthxheightxdepth):	150 x 120 x 70 mm (6 x 4 x 3 inch)
	Weight:	1.2 kg (2.6 lbs)
	Cable entry:	2 x M20, cable diameter 7-14 mm (specified in order) 1x M25, cable diameter 9-18 mm (specified in order)
	Optional:	½ inch NPT and ¾ inch NPT by external adapters
	Ingress protection:	IP 66 & 67

Field Communication Unit, FCU 2160

The Field Communication Unit (FCU) is a data concentrator that continuously polls data from field devices such as Radar Tank Gauges, Data Acquisition Units and Remote Display Units and stores them in a buffer memory. Whenever a request for data is received, the FCU can immediately send data from a group of tanks from the updated buffer memory.

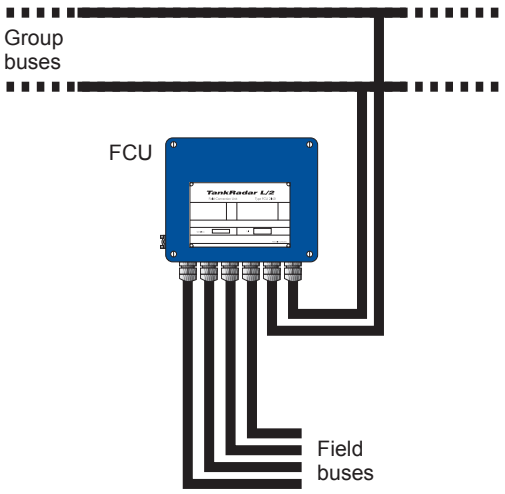
The FCU acts as a slave on the group bus and as a master on the field bus. The unit has six communication ports. The ports can be individually configured as either group bus ports or as field bus ports according to one of the alternatives below:

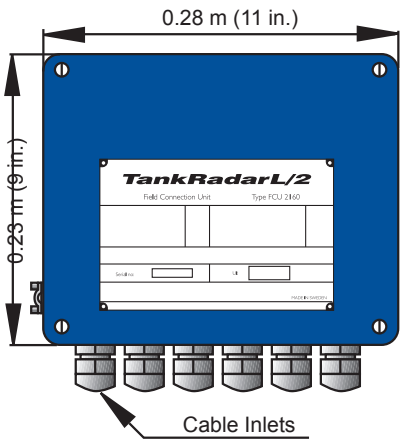
Alternative	No. of field bus ports	No. of group bus ports
1	4	2
2	3	3
3	2	4

An interface board can be connected for each communication port. These boards can be either FCM boards for the TRL/2 Bus or FCI boards for RS485 communication. Two group bus ports can also be configured as RS232 by connecting a jumper connector instead of an FCM or FCI board. As standard the Field Communication Unit is delivered with six FCM boards and two RS232 jumper connectors.

Each RTG has an individual address on the field bus. The DAU 2100 and the RDU 40 use the same address as the RTG they are connected to and do not have separate addresses.

Two FCU:s can be connected in parallel with one unit operational and one working as “hot” redundant backup for the other. The units are software monitored and the backup unit is automatically triggered and activated in case of primary unit failure. See page 42 for more information.





FCU 2160 Field Communication Unit.

Technical Data for FCU 2160		
Explosion protection:	None	
Ambient operating temperature:	-40 °C to 70 °C (-40 °F to 158 °F)	
Power Supply:	115 or 230 VAC, +10% to -15%, 50-60 Hz, max. 10 W	
Ingress protection:	IP 65	
Communication:	Field bus ports:	TRL/2 Bus, modified Modbus protocol
	Number of RTG:s per field bus port:	Max 8 is recommended
	Group bus ports:	TRL/2 Bus, RS232 or RS485, Modbus based protocol
	Group bus baud rate:H	Programmable up to 19 200 Baud
	Host communication via group bus ports:	Various protocols available, see page 44
Number of tanks per FCU:	Max 32 (max 8 per field bus is recommended)	

The FCU works as a data concentrator for a group of tanks ensuring fast data communication from the tanks to the control room.

Field Communication Unit, FCU 2165/2175

The Field Communication Unit, FCU 2165/2175 is a data concentrator that continuously polls data from field devices such as radar and servo tank gauges from different vendors, Data Acquisition Units, I/O Modules, other FCU:s, Enraf® CIU:s etc and stores data in a buffer memory. Whenever a request for data is received from a host, the FCU can immediately send data from the updated buffer memory.

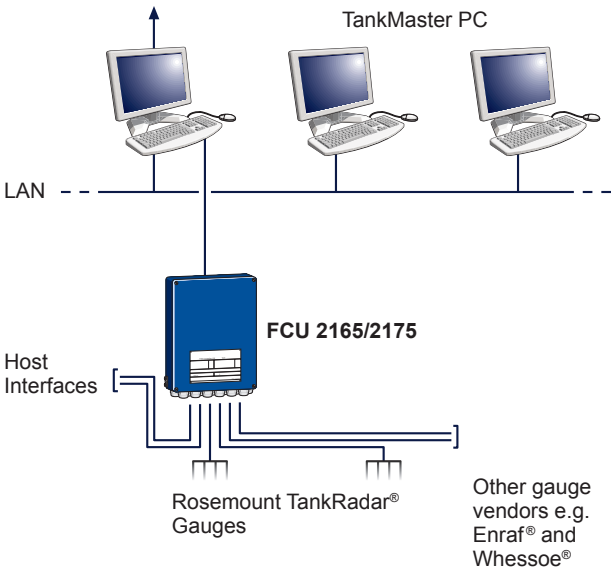
The FCU can service requests from a wide range of hosts/DCS systems such as Rosemount TankMaster®, Enraf® Entis, Yokogawa®, ABB®, Honeywell®, Foxboro® among others (it is posssible to connect any system using the Modbus protocol). Each of the ports can be configured either as a master or slave connection, providing ultimate configuration flexibility.

The FCU 2165 has 10 ports of which maximum 6 can be used as field bus ports. The FCU 2175 can be ordered with 8, 16, 24 or 32 ports. Port configuration flexibility along with the scalable solution make the FCU meet the needs of the small terminal operator to the largest refinery, also for the most demanding applications.

For applications requiring more capacity or when devices are distributed over a large area, multiple FCU:s can be used. Two FCU:s can also be connected in parallel with one unit operational and the other as a redundant backup. The backup unit is automatically activated in case of a primary unit failure (hot standby).

The number of devices per port varies between different manufacturers and may also have physical limitations imposed by the quality and length of field cables and distribution of devices. Maximum 256 devices can be supported by one FCU 2165/2175.

FCU 2165.



FCU 2175.

Technical Data for FCU 2165 / 2175	
Explosion protection:	None
Ambient operating temperature:	-20 °C to 70 °C (-4 °F to 158 °F)
Power Supply:	115 or 230 VAC, +10% to -15%, 50-60 Hz
Power Consumption (max):	25 W (FCU 2165) 60 W (FCU 2175)
Ingress protection:	IP 65 (FCU 2165) IP 21 (FCU 2175)
Field bus / host ports:	TRL/2 Bus, Enraf BPM, Whessoe Current Loop, RS232, RS422, RS485 (additional will follow)
Baud Rates:	Programmable up to 38400
Total number of gauges per field bus port:	Dependent on vendor, consult factory
Number of tanks / gauges per FCU:	Up to 256 (host dependant, 160 for TankMaster)
Dimensions:	FCU 2165: 111x313x404 mm (4.37x12.32x15.91 in.) FCU 2175: 19 in. (3U rack)
Configuration Possibilities	
As a master (field bus) port the FCU can talk to a wide range of different tank gauges such as:	Rosemount TankRadar Enraf® Servo and Radar Whessoe® Servo and Level / Temperature Transmitter Motherwell®
As a slave port the FCU can service requests from a wide range of hosts using various protocols:	TankMaster Modbus RTU Enraf® Entis

The number of gauges on each field port is limited by the gauge vendor protocol and / or the electrical interface capability. Typically these are as follows:

Equipment	Electrical Interface	Max Gauges / Interface
Rosemount		
2900, 3900, Pro	TRL/2	8
FCU 2160	RS232, RS485 or TRL/2	32
Enraf®		
CIU 858	RS232	30
CIU 880	RS232	50
GPU or GPP protocol gauges	BPM	10
Microlect		
Whessoe®		
WM 550 protocol gauges	Current Loop	32
WM 500 protocol gauges	Current Loop	256 (via 16 Outstations)

The FCU 2165/2175 can replace an Enraf Microlect or CIU unit.

Field Bus Modem, FBM 2180

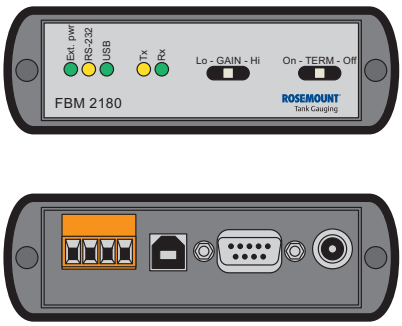
The FBM 2180 is used for connecting a TankMaster HMI software PC to the TRL/2 Bus.

The FBM 2180 is connected to the PC using either the RS232 or the USB interface (TankMaster version 4.F1 or higher required for the USB interface functionality), and has LEDs indicating power on and communication. For the TRL/2 interface, there are front panel switches to set gain and termination if required. FBM 2170 and FBM 2171 can easily be replaced by the FBM 2180 in existing installations.

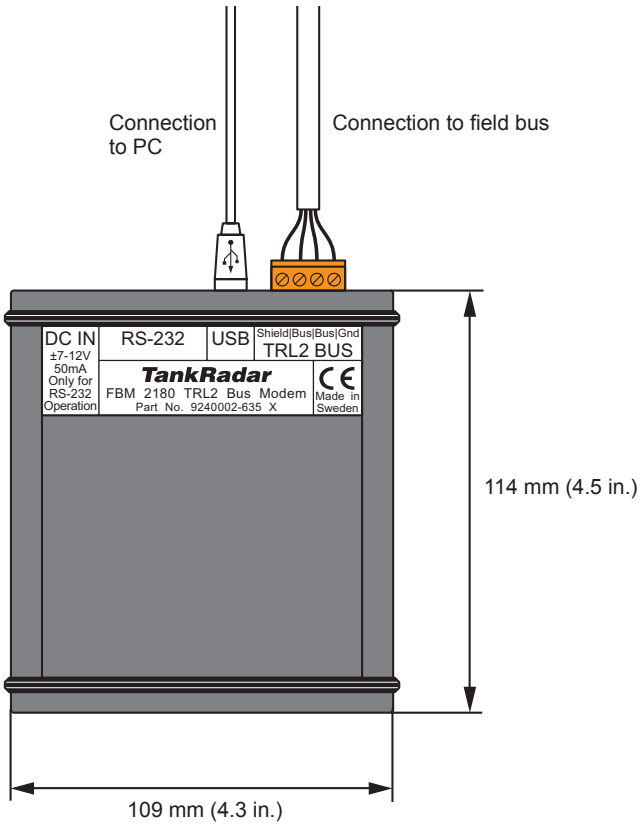
The mechanical mounting of the FBM 2180 is performed using the mounting kit included in all deliveries. This kit enables fitting of the FBM 2180 to a standard DIN rail.

The Field Bus Modem is delivered with cables for RS232 and USB connection to the PC. The USB cable also supplies power to the FBM 2180. A separate power supply cable (included in delivery) is only necessary for the RS232 option.

Technical Data for FBM 2180	
Explosion protection:	None
Power supply (only used for RS232):	AC/DC converter supplied for Rosemount TankRadar® products (7-12 V, 50 mA).
Cable to PC:	RS232: 3 m (10 ft). USB: 3 m (10 ft). Included in delivery.
Field bus over voltage protection:	Galvanic insulation, and transient suppressors.



FBM 2180 Field Bus Modem.



Junction Boxes

As optional equipment a series of junction boxes can be delivered with the TankRadar Rex system. These are used to connect the various system units. (The junction box integrated in the Transmitter Head is described on page 15.)

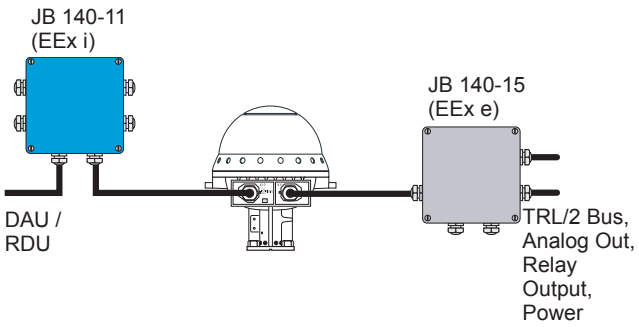
JB 140-11 and JB 140-15 for EEx i and EEx e environments

JB 140-11 (EEx i) is used when a DAU or an RDU 40 is located more than 2 m away from the RTG and should only be used for intrinsically safe connections.

JB 140-15 (EEx e) is used to connect power and the TRL/2 Bus to the RTG.

Both Junction Boxes contain 15 terminals. JB 140-11 has six openings for M25 glands and JB 140-15 has five openings for M25 glands, suitable for 9-16 mm cable diameter.

Note: JB 140-15 is not an approved protection on all markets.



Junction boxes for EEx i and EEx environments.

JB 36 and JB42 for connection of temperature sensors

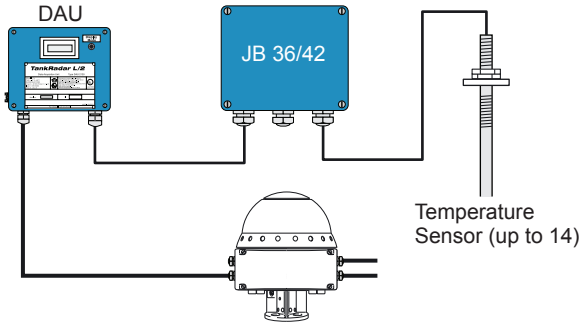
JB 36 and JB42 are used for intrinsically safe connection of up to 14 temperature sensors to a Data Acquisition Unit (12 for JB 36 if 3-wire connection is used).

JB 36 and JB42 have three openings for M25 glands, suitable for 9-16 mm cable diameter.

There are two alternative connections of temperature sensors to the Junction Box:

- Connection via cable
- Direct connection

If the DAU is situated on the tank top, temperature sensors can be connected directly to the DAU.



Junction box for connection of temperature sensors via cable.

Junction Box Integrated with Temperature Sensor or Water Level Sensor

There is also a Junction Box available which can be integrated with the temperature sensor or water level sensor.

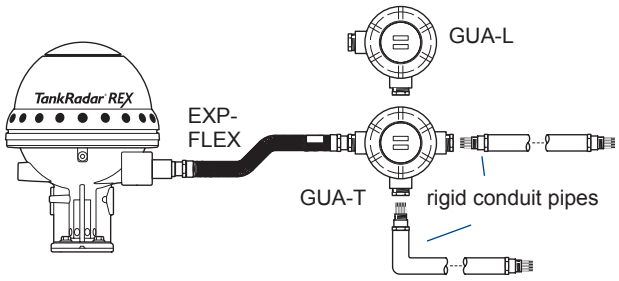
Junction Boxes with Conduit Outlets

In the US wires from the transmitter head must be enclosed in a protective steel braided hose.

Further connection to conduit pipes requires an explosion proof Junction Box with L or T-shaped outlets, both variants available with 12 or 15-pin terminal blocks for wiring.

The three-feet hose, EXP-FLEX, and Junction Boxes (GUA-L and GUA-T) can be supplied together with the Rex gauge.

The Junction Box can be installed directly on the transmitter head by using a suitable adapter with 3/4-inch male fitting facing the transmitter head outputs.



Connection to rigid pipes via a Junction Box with conduit outlets.

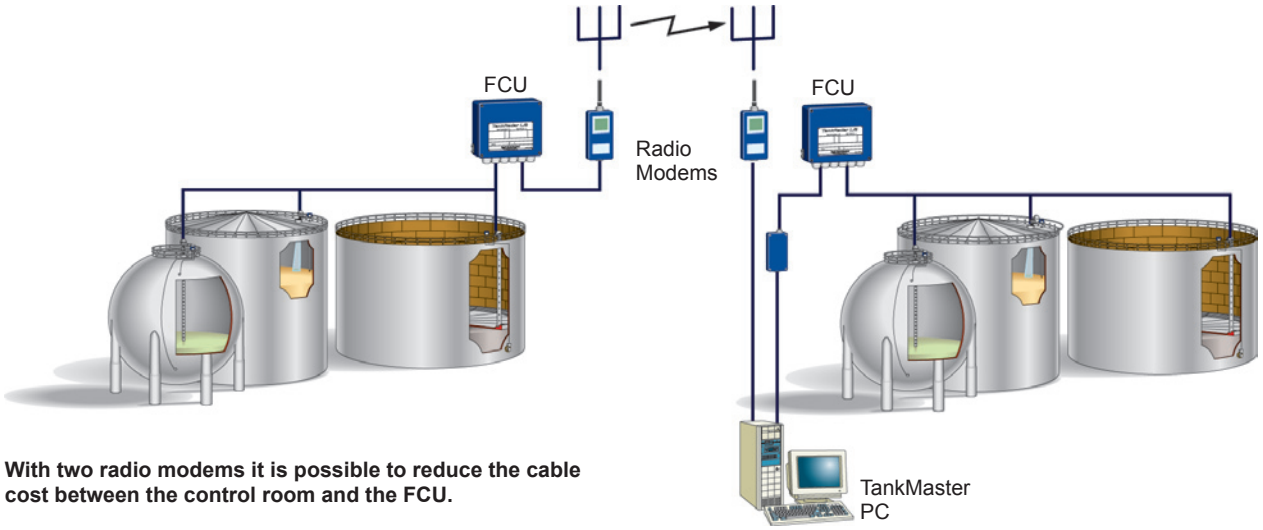
Radio Modem

It is possible to use high speed UHF Radio Modems instead of cable to make point-to-point connection between the control room and the Field Communication Unit (FCU). Communication is completely transparent so the radio modems work just like a cable connection.

The radio modem can be connected to the serial port on the TankMaster PC / Host Computer or to the group bus port of an FCU.

In case there is a need to extend the coverage, a radio modem can be used as a repeater.

Depending on topographical conditions as well as gain and installation height of the antenna, the operating range is up to 40 km (25 miles).



With two radio modems it is possible to reduce the cable cost between the control room and the FCU.

Technical Data for Radio Modem		
Frequency range:	380 - 470 MHz, Half-Duplex	
Frequency stability:	< ± 1.5 kHz	
Channel spacing:	12.5 / 25 kHz	
Number of channels:	160 / 80	
Transmitter:	Carrier power: Carrier power stability: Adjacent channel power: Spurious radiation:	10 mW to 1 W / 50 Ω +2 dB / -3 dB according to EN 300 220-1 / ETS 300 113 according to EN 300 220-1 / ETS 300 113
Receiver:	Sensitivity: Co-channel rejection: Adjacent channel selectivity: Intermodulation attenuation: Spurious radiation:	-116 to -110 dBm (BER 10^{-3}) > -12 dB > 60 dB / > 70 dB > 65 dB < 2 nW
Modem:	Interface: Interface connector: Data speed of RS interface: Data speed of radio interface:	RS232, RS422 or RS485 D15, female 300 to 38400 bps 19200 bps (25 kHz channel) 9600 bps (12.5 kHz channel)
Data formats:	Asynchronous data	
Power supply:	9 to 30 VDC	
Power consumption (typical values):	1.8 W (receive), 6.0 W (transmit)	
Temperature range:	-25 °C to + 55 °C (-13 °F to 131 °F)	
Antenna connector:	TNC, 50 Ω, female	
Size (HxWxD):	137 x 67 x 29 mm (5.4 x 2.6 x 1.1 inch)	
Weight:	250 g (0.6 lbs)	

TankMaster HMI software

TankMaster is a powerful Windows-based Human Machine Interface (HMI) for complete tank inventory management. It provides configuration, service and set up, inventory and custody transfer functions for TankRadar Rex systems. All calculations are based on current API and ISO standards.

TankMaster follows the OPC standard and can communicate with Microsoft® programs and OPC compatible systems like Intellution's iFIX® and Wonderware's InTouch®.

TankMaster has customized views with graphic plant layouts, and advanced group configuration in geographical or product groups etc.

TankMaster includes a user manager with different access levels for personnel.

TankMaster consists of two main software modules:

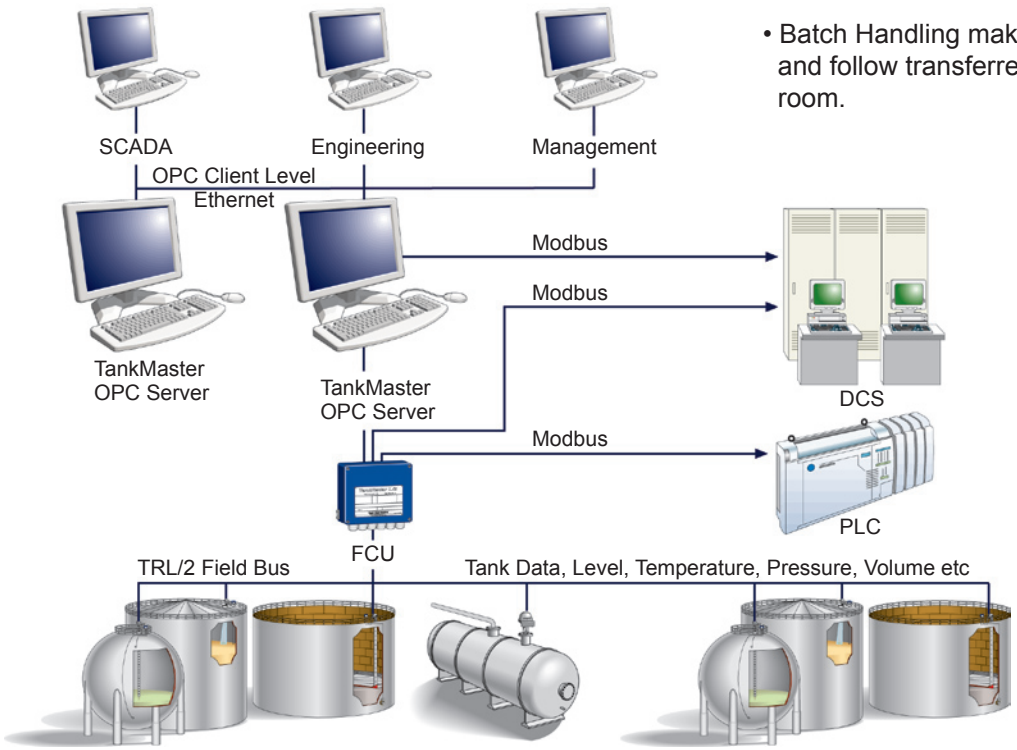
- WinSetup is the software package used for configuration of the total Rex system. The WinSetup package is included with all TankRadar Rex deliveries as a set-up and configuration tool (other functions are options depending on which package is used).
- WinOpi is a complete inventory software package.

TankMaster has a set-up wizard for interactive configuration and installation.

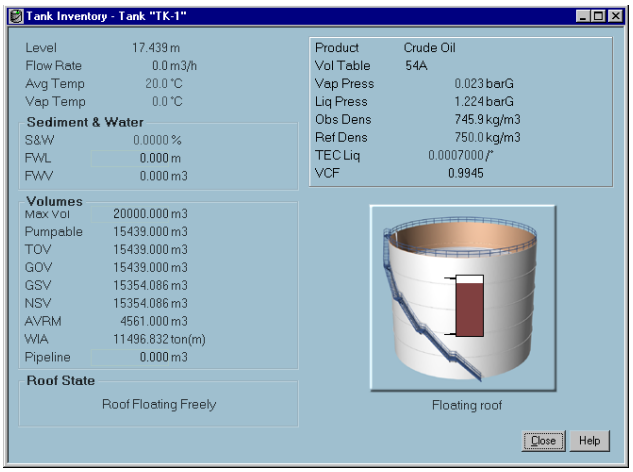
TankMaster is easily translated to other languages than English.

Inventory and custody transfer functions

- Real time tank gauging data such as level, temperature, water interface level and pressure.
- Real time, gross and net volume inventory calculations based on API and ISO.
- Hybrid tank gauging with pressure inputs giving data for density and mass calculation.
- Metrologically sealed data.
- API calculator.
- Batch Handling makes it possible to control and follow transferred volumes, from the control room.



TankMaster distributes essential inventory tank gauging data.



TankMaster gives the most important inventory data for a specific tank in one easy-to-read window.

Networking and interfacing

- OPC server with browser for easy interface with other plant computer systems.
- Full network capabilities.
- SCADA / DCS communication via MODBUS.
- SCADA / DCS communication via OPC.
- Integration with other tank gauging systems by taking in and displaying data from other vendors' gauges.

Reports and data sampling

- Batch report for internal and external transfers.
- Customized Reports to Microsoft Office programs.
- Automatic reports.
- Reports via e-mail.
- Audit log for events.
- Historical data sampling.

Alarms

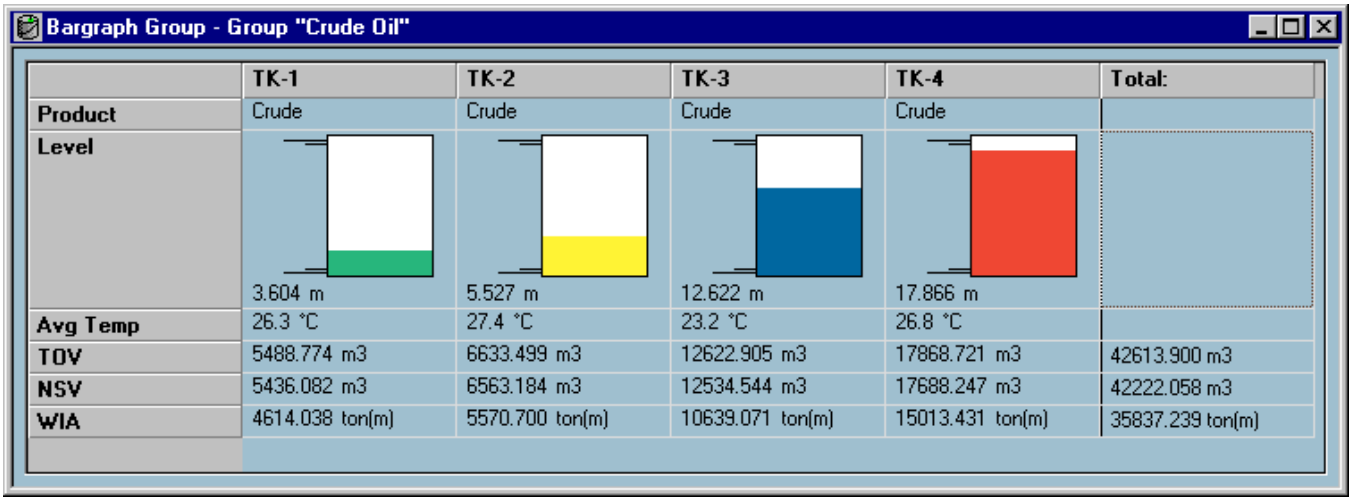
- Reliable alarm handling of measured values with high, high-high, low and low-low level alarms.
- Alarms to mobile phones.
- Alarms via e-mail.
- Leakage alarms based on net volume.

Emulation

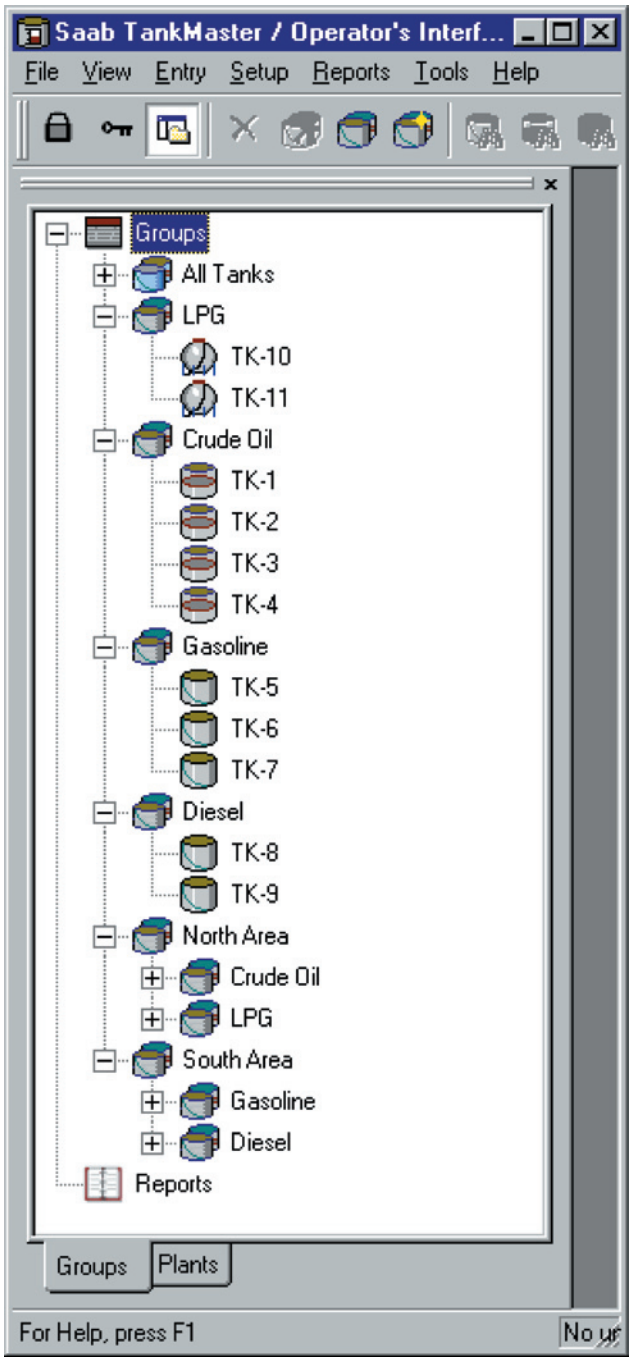
TankMaster supports a wide range of protocols for gauge and control room emulation. See pages 14, 45 and 48.

TankMaster hydrostatic tank gauging

The TankMaster HTG system is an intelligent direct mass measuring system which uses product hydrostatic pressure measurement to derive both the specific gravity and liquid level. See TankMaster HTG Technical Description for more information.



You can easily organize the tanks in e.g. geographical or product groups, with associated sub-groups. For example you can choose to see the actual tank gauging and inventory data in a bargraph group, giving a quick overview of tank farm activity.



The "tank farm explorer" makes it easy to navigate in TankMaster. Just like in "Windows explorer" it is possible to expand and minimize fields and get direct group and tank access by double-clicking the specific group or tank icon.

PC Requirements

Required operating system:
Windows XP (SP 1) is recommended for WinOpi, WinSetup and TankMaster servers.
Windows 2000 (Sp 3 or later) or Windows NT 4.0 (SP 6 or later) can also be used.

Required PC hardware:

- 1.5 GHz or better.
- 512 MB RAM (1024 MB for server PC).
- 20 GB disk drive.
- Graphics card 1024*768 pixels, 65536 colors (16 bit).

For further information a separate TankMaster brochure is available.

TankMaster I/O Terminals

The I/O Terminals can be used for communication between TankMaster and field equipment, for a more versatile system. The four versions are:

- IOT 5110 for Analog Inputs
- IOT 5120 for Analog Outputs
- IOT 5130 for Digital Inputs
- IOT 5140 for Digital Outputs

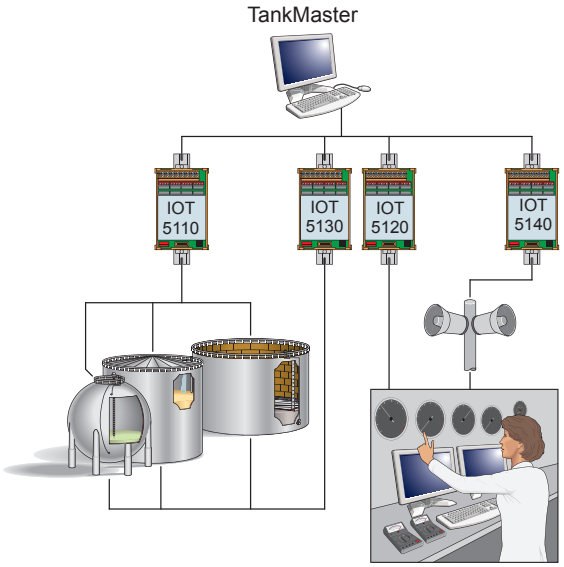
The analog inputs open up TankMaster for all 4-20 mA devices, such as pressure and temperature sensors.

The analog outputs enable mapping of values to analog indicators.

The digital inputs can for example be used to display alarms from external equipment in TankMaster.

The digital outputs can be used for alarm panels, horns, signal lamps etc.

The I/O terminals are complements to the TankMaster system, and are not designed to be used as stand-alone devices for critical operations.



Technical Data for TankMaster IOT 5110-5140	
Communication type:	RS485
Communication speed:	115 kbit/s
Isolation:	Opto-coupled (in I/O box)
Terminal size:	160x100x80 mm (6.3x3.9x3.2 in.)
Mounting method:	DIN rail 35 mm (1.4 in.) clip
Supply voltage:	24 VDC
Approved environment:	0 °C to + 55 °C (0 °F to +130 °F)
IOT 5110 Analog In; 4-20 mA, 0-10 V	
Channels:	16 single ended
Input load:	50 Ω (current), 10 k Ω (voltage)
Accuracy (current and voltage):	Max ± 0.5 % of full range
Temperature drift (current and voltage):	Accuracy valid for 0 °C to + 55 °C (0 °F to +130 °F)
IOT 5120 Analog Out; 4-20 mA, 0-10 V	
Channels:	16 single ended
Load impedance:	50 Ω / max 500 Ω
Load current:	< 5 mA for 0-10 VDC
Accuracy (current):	Max ± 0.5 % of full range
Accuracy (voltage):	Max ± 0.2 % of full range
Temperature drift (current and voltage):	Accuracy valid for 0 °C to + 55 °C (0 °F to +130 °F)
IOT 5130 Digital In	
Channels:	16 negative common
Voltage range input:	0 to +35 VDC
Source type:	Potential free contact
Input current:	Max 0.6 mA
IOT 5140 Digital Out	
Channels:	8 pot free SPDT
Capacity:	Max 250 VAC, 2A

Tank inventory, density & hybrid calculations in the Rex system

The TankRadar Rex gauge, with its high capacity signal processor is designed to make basic inventory calculations directly in the gauge.

The gauge can receive and process signals from analog and digital pressure transmitters, water bottom sensors etc. Measured data is transmitted on the field bus and can be further processed in the control room by the TankMaster PC software or by the plant's host computer/DCS system.

Density measurement with pressure transmitters
When the RTG is connected with a pressure transmitter near the bottom of the tank, the density of the product can be calculated and presented on-line. The accuracy of the density calculation largely depends on the accuracy of the pressure transmitter. TankRadar Rex can interface to any pressure transmitter with a standard output of 4-20 mA or HART. The 4-20 mA signal is converted from analog to digital form in the RTG.

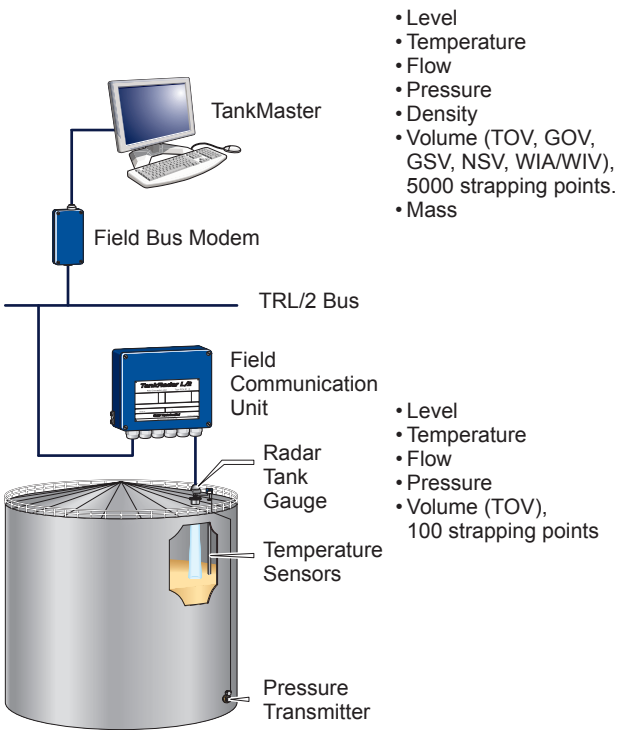
The gauge calculates (or receives inputs for) the following data:

- Total Observed Volume (TOV) using the tank strapping table (100 strapping points).
- Observed density (if pressure sensor connected)
- Level (corrected for thermal tank wall expansion)
- Temperature
- Oil/Water interface level.

Data is calculated according to updated API and ISO standards. Temperature calculations include API algorithms to handle elements close to the bottom. The level value is software corrected for changes in tank reference height.

Both metric and USA/UK units are supported.

If very high accuracy net volume calculations (up to 5000 strapping points) are required, the TankMaster PC software package is used, see page 35. Normally less than 100 points per tank are necessary for 1 liter accuracy.
TankMaster is using quadratic interpolation for spheres and horizontal cylinders, which increases volume accuracy and reduces number of strapping points.



By complementing the level measurement with temperature and pressure measurement, the density of the product in the tank can be continuously calculated and provided on-line.

TankRadar Rex System Configurations

The TankRadar Rex system can be applied to a single tank or to large and very complex systems. All system configurations are based on the same basic parts.

The TRL/2 Bus - A fast and reliable data bus

In the descriptions below the TRL/2 Bus is divided into two parts:

- Group bus
- Field bus

Both buses work in the same way with the same technical specifications. However, the Group Bus is defined as the TRL/2 Bus between the TankMaster/ host computer (DCS) and the FCU:s, while the field buses connect the DAU:s, RDU:s and the RTG:s with the FCU:s.

TankMaster communicates on the TRL/2 Bus via a Field Bus Modem. The Field Bus Modem translates the signals from RS232 to TRL/2 Bus and vice versa.

The TRL/2 Bus was developed to minimize the updating times as well as to provide a robust and reliable field bus for transferring the measured values from the tanks to the control room.

Each Field Communication Unit continuously collects data from up to four TRL/2 field buses and stores the values in a buffer memory. When a query reaches the Field Communication Unit from the TankMaster or from a plant host computer on the group bus, it can quickly send data directly from the database.

Each RTG has an individual address on the field bus. The DAU 2100 and the RDU 40 use the same address as the RTG they are connected to.

The recommended maximum number of RTG:s on one field bus is 8 (The maximum number of RTG:s per FCU is 32).

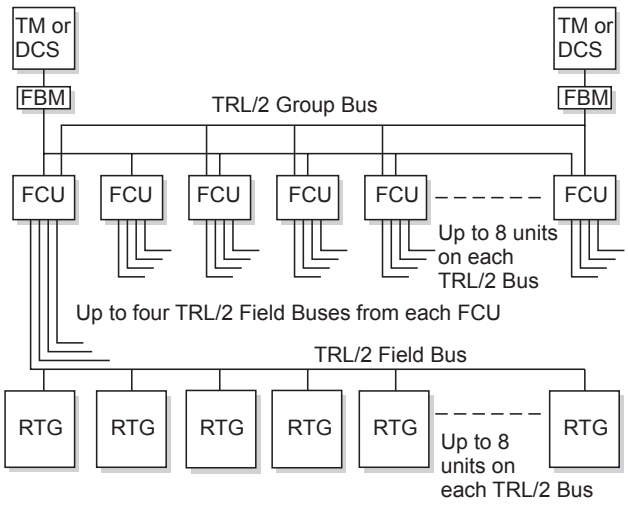


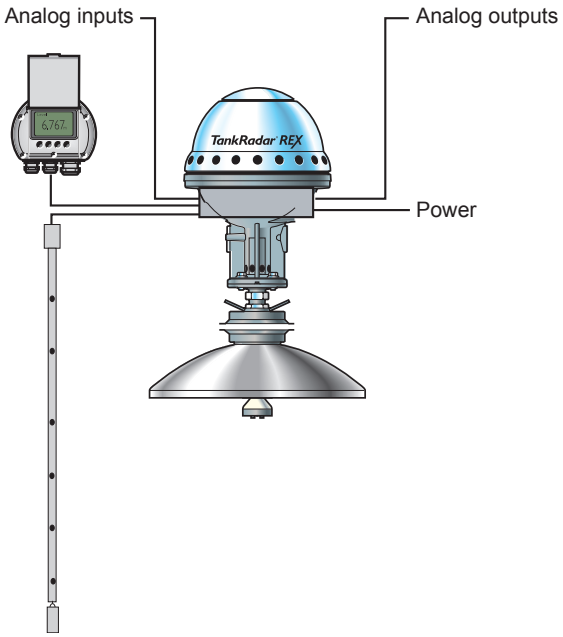
Figure showing how the TRL/2 Bus is used in the TankRadar Rex system.

Technical Data for TRL/2 field bus	
Number of units:	Max 8 RTG:s with associated DAU 2100 units or RDU:s are recommended on one TRL/2 Bus (see also next page)
Cable:	Twisted and shielded pair
Cable area:	Min 0.50 mm^2 AWG 20
Cable length:	Max 4 km (2.5 miles)
Modulation type:	FSK (frequency shift keyed), half duplex

Stand-Alone Application

A stand-alone Radar Tank Gauge can be used to measure on a single tank. The measured level is output on the field bus or as an analog 4-20 mA signal. The RTG can also include 4-20 mA inputs or temperature inputs.

A DAU 2100 or an RDU can be connected to the stand-alone gauge.



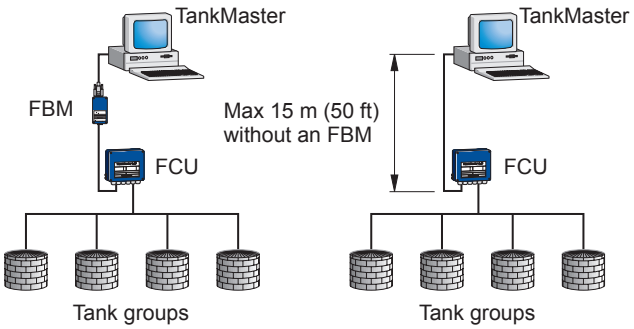
In a stand-alone configuration the analog output can be used to connect an analog display. If connecting a DAU 2100 or the RDU 40, all measured values can be displayed.

Systems with a TankMaster Work Station

The TankMaster PC can be connected via RS232 directly (without a Field Bus Modem) to one Field Communication Unit if the FCU is placed close to the PC. If more than one FCU is used, FBM:s or RS485 communication is required.

Normally the Field Bus Modem, FBM, is connected to the TankMaster PC. The FBM is then connected to the FCU and uses the TRL/2 Bus. The FCU does not need to be close to the TankMaster PC in this case.

Both communication ports of the TankMaster can be used to connect TRL/2 group buses.



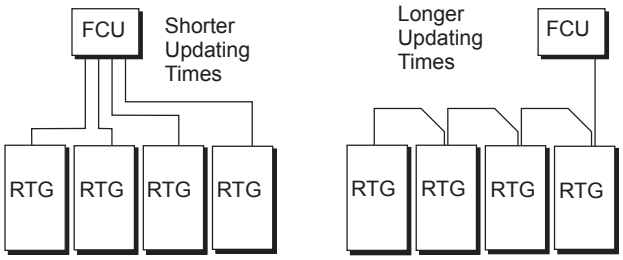
The connection between TankMaster and FCU.

Connecting the Field Communication Unit FCU 2160

The FCU is very flexible. There are six communication ports on the FCU. Normally four of these ports are used for field buses. However, it can have up to four group bus ports.

The FCU can handle up to 32 RTG:s plus associated DAU 2100 units or RDU:s. Each field bus could connect up to 16 RTG:s. However in order to ensure robust data communication maximum 8 RTG:s are recommended per field bus.

To increase the updating speed of the FCU, the number of connected RTG:s should be approximately the same on each field bus connected to one FCU.



The updating times are improved if the units are evenly spread out on the field buses of the FCU.

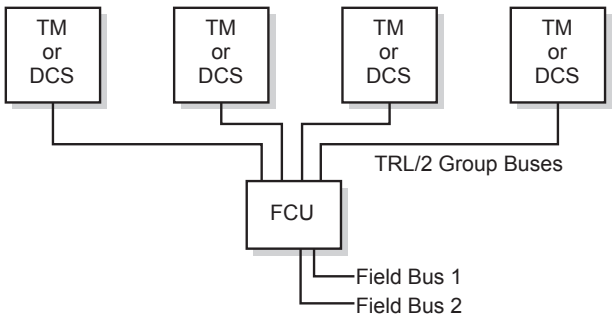
Redundancy

In order to reduce the risk of communication failure between the TankMaster/DCS system and the units connected to the TRL/2 field bus, redundancy can be made in several ways.

Several Group Buses

An FCU can connect up to four group buses with different masters, like TankMaster PC:s and DCS units, asking the FCU for data.

A system can for example have two TankMaster PC:s connected via two different group buses.



There can be up to four connections to TankMaster (TM) or DCS units on the group bus ports of the FCU.

Redundant FCU:s

Using two FCU:s provides redundancy on both FCU and host computer level. With two FCU:s connected in parallel to the field buses, one of the FCU:s will be configured as the primary FCU and will be in an active state. The other FCU will be in a back-up state. The backup FCU listens to the communication on the field bus. If the communication on the field bus ceases for a certain delay time, the backup FCU will take over and communication will be resumed.

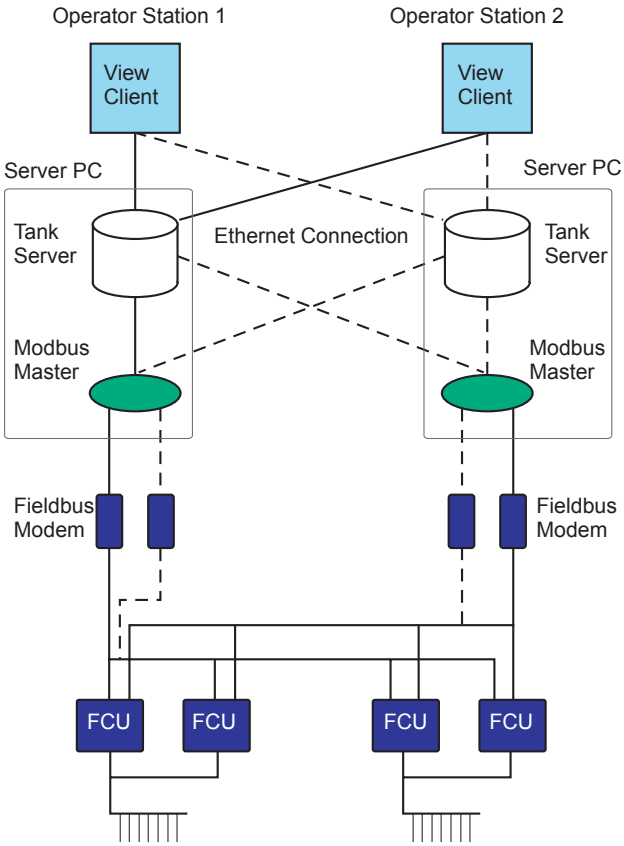
A message is sent to the TankMaster (or DCS) that the primary FCU has failed and that the backup FCU has taken over the communication.

Double FCU:s and workstations

A complete redundancy from control room to RTG:s is achieved by using double FCU:s as well as double TankMaster work stations.

Redundant FCU:s, FBM:s and workstations

With two FBM:s, safe communication between the TankMaster workstation and the FCU is achieved.

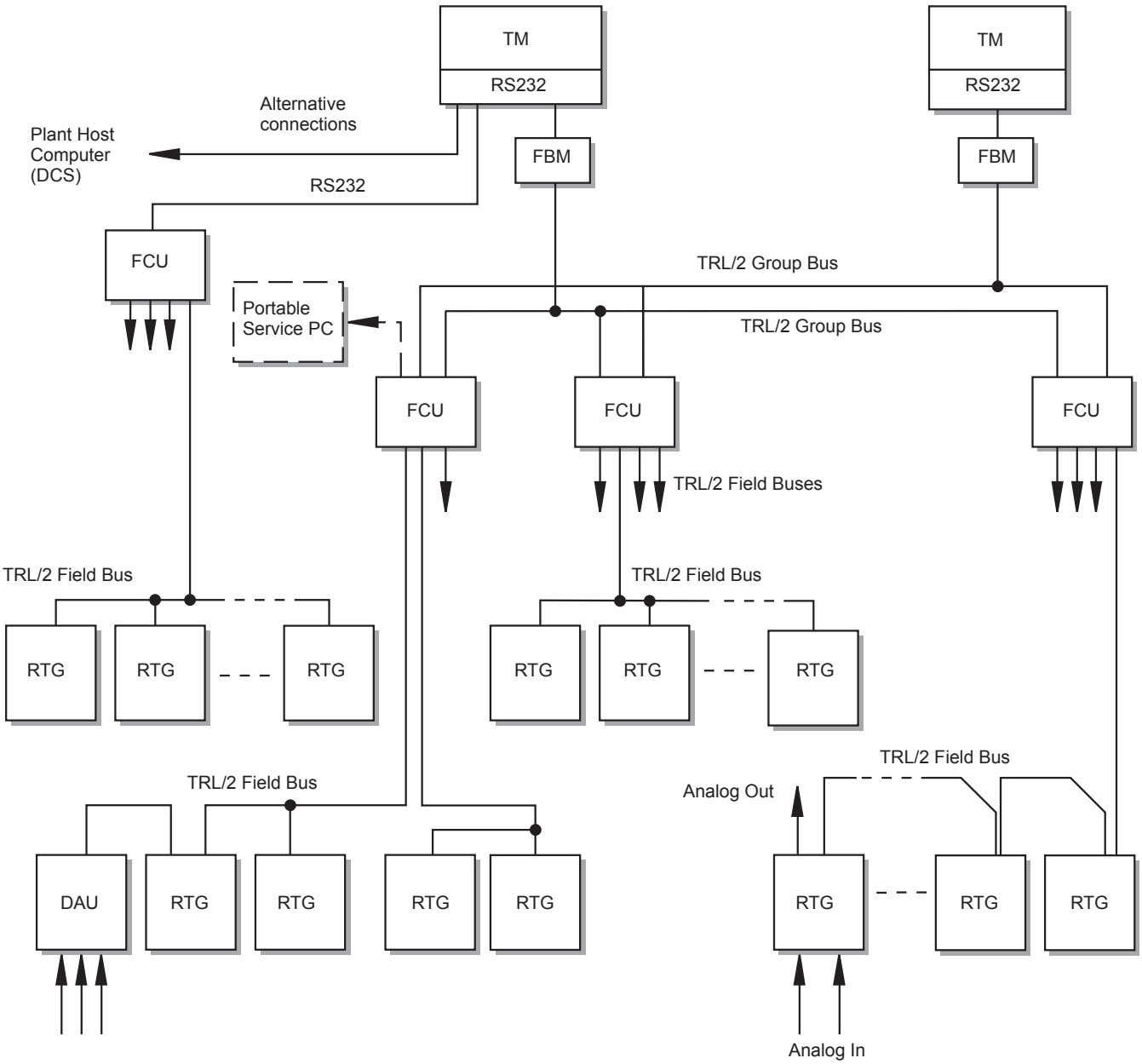


The flexible TankRadar Rex system supports several possible combinations to achieve redundancy, from control room to the different field units and RTG:s.

FCU:s connected to run in parallel provide automatic redundancy. If one unit fails the other will take over the communication.

Example of a General System

The figure below shows an example of a general TankRadar Rex system.



Connection to other systems

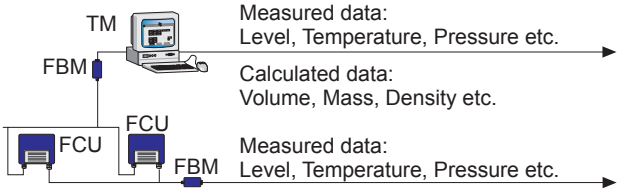
The TankRadar Rex system can be connected to all major suppliers of DCS, SCADA systems, plant host computers or terminal automation systems. The connnection can be made in two ways:

- To a TankMaster PC workstation.
- Directly to a Field Communication Unit.

The advantage of connecting to a TankMaster workstation is that not only the measured values, but also the values calculated by the TankMaster can be communicated.

Examples of available protocols are given below. Certified test reports are available for most of the protocols.

If you require a protocol which is not included in the list, contact Emerson Process Management / Rosemount Tank Gauging as new protocols are developed on a regular basis.



The host computer can be connected either to a TankMaster (TM) PC or directly to the FCU.

Examples of Vendors and Interfaces

Vendor / Application	Interface	Vendor / Application	Interface
ABB®	Modbus, OPC	ENRAF®	GPU
A-B / CSI TMS	Modbus	Fisher®	Modbus
AEG Viewstar®	Modbus	Foxboro®	Modbus
Allen-Bradley®	Data Highway Plus, Modbus	GE Fanuc PLC	Modbus
Asea Master System	Modbus	Honeywell®	Modbus, OPC
Bailey®	Modbus	Intellution FIX	Modbus, OPC
CSI®	Modbus	Rosemount®	Modbus
E+H®	Modbus, OPC	Siemens CS7 TMS	Modbus
Emerson Dantas	Modbus	Tokyo Keiso® / CATAMS	Modbus
Emerson Delta V®	Modbus, OPC	Yokogawa Centum CS	Modbus

Communication Protocols

Enraf®	GPP, GPU, 45C
GPE®	GPE
L&J®	TankWay
Motherwell®	2800, 4000
Sakura®	MDP
Texas Instruments®	Tiway
Varec®	1800, 1900
Whessoe®	WM 500, WM 550
Generic	• Analog & Digital I/O • FOUNDATION™ fieldbus (FF) • HART® • Profibus® DP • 4-20 mA

Emulation

The TankRadar system is compatible with all major tank gauging systems. It provides field and control room solutions.

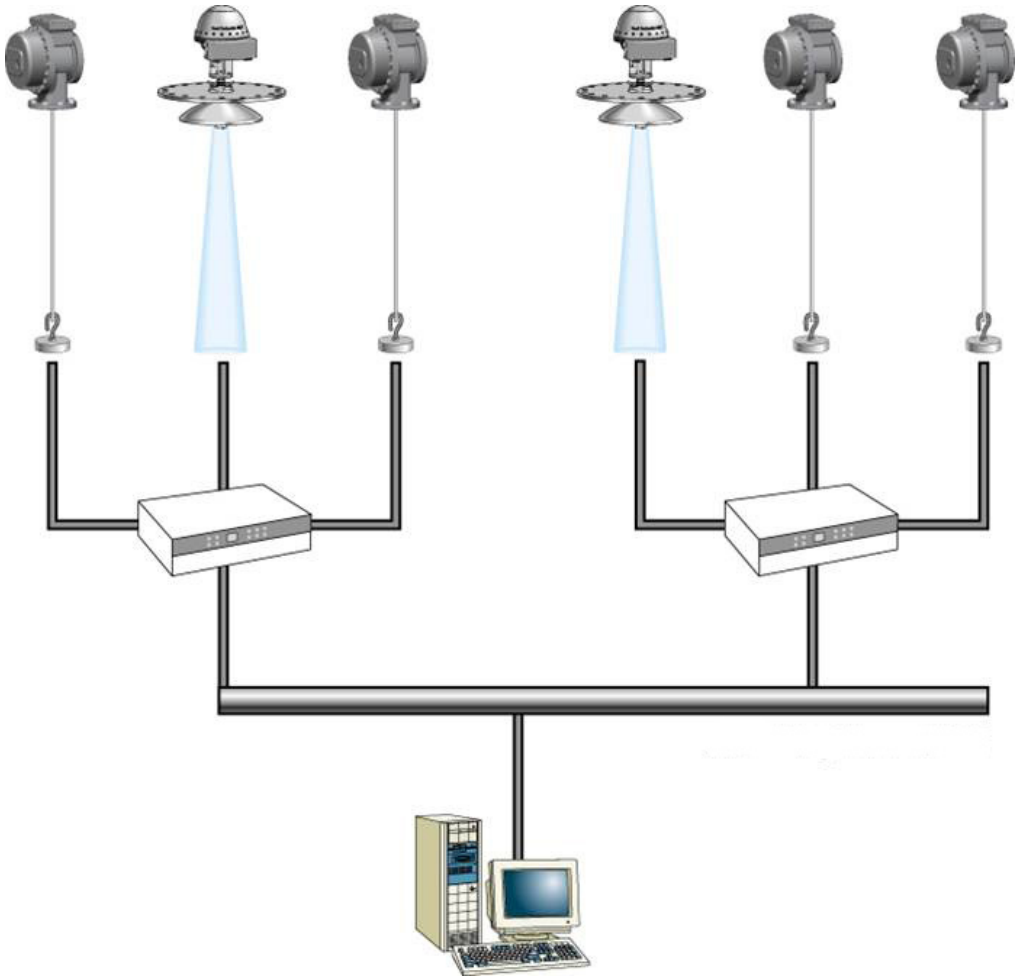
The Rex gauge is designed with an open interface, covering everything from electrical interface and communication protocol to utilization of many different power sources.

This feature makes it possible to replace old mechanical or servo gauges with modern Rex gauges, without having to replace the control system or field cabling. Simply Plug-and-Play.

With the FCU 2165/2175, emulation of different host systems and other control room devices is possible. Also see separate section “Field Communication Unit FCU 2165/2175”

This flexibility makes step-by-step upgrade of your tank gauging system a reality.

See section “Radar Tank Gauges” (Technical Data for the Transmitter Head) for information on communication protocols.



With TankRadar Rex you are no longer stuck with your old system. By replacing old servo gauges, re-calibration and expenses for spare parts and maintenance can be avoided.

Certificates

The list below includes the certificates and approvals of the TankRadar Rex system at the time of the printing of this description.

Please note that the list does not give any detailed information on each certificate or approval.

There may be restrictions in them, for example, a certificate may be valid for only parts of the TankRadar Rex system.

Contact Emerson Process Management / Rosemount Tank Gauging if you require more information on any of the certificates.

Accuracy approvals / Legal metrological certificates

- OIML R85 (E) International, Statens Provningsanstalt, SP, Sweden
- BEV, Austria
- Belgium Metrological Inspection, BMS, Belgium
- China Metrological Institute, China
- Physikalisch Technische Bundesanstalt, PTB, Germany
- Ministry of Civil Supplies, W & M, India
- Nederland Meet Institute Ijkwesen, NMI, The Netherlands
- LNE, France
- Metric Office, Italy
- METAS, Switzerland
- GUM, Poland
- BRML, Romania
- GOSStandard, Russia
- GOSStandard, Kazachstan
- GOSStandard, Belarus
- SIRIM, Malaysia
- Thai Excise and Customs, Thailand
- GOSStandart, Ukraine
- MIGAS, Indonesia
- CMI, Czech Rep.
- FBM/PM, Serbia
- IPQ, Portugal
- TJI, Estonia
- ONML, Algeria
- Republika Hrvatska Drzavni Zavod za Mjeriteljstvo, Croatia
- OMH, Hungary
- Directorate of Weights and Measures, Ministry of Commerce, Greece (pending)

In addition to the accuracy approvals listed above, many countries are presently in the process to define custody transfer requirements.

Approvals for installation in hazardous areas

- BASEEFA (2001)/ATEX, Europe
- BASEEFA (2001)/IEC Ex Certificate of Conformity
- Underwriters Laboratory, UL, USA
- C-UL, Canada
- JIS, Japan, part of approval pending
- TÜV, Austria
- GOSStandard, Russia
- GOSStandard, Ukraine
- GOSStandard, Kazachstan
- GOSStandard, Belarus, pending
- Department of Explosives, India

Emission Approvals

The listed approvals below deal with how much radiated power that is sent out from the radar gauge.

In most countries there are no formulated requirements on equipment like a radar gauge, due to the very low output power and the fact that it is normally installed in a metallic tank.

TankRadar® gauges have been tested in accordance with CISPR-22 and CISPR-16.

The certificates listed below are exceptions for specific countries:

- Bundes Ministerium für Post und Telekommunikationen, BMPT, Germany
- Federal Communications Commission, FCC, USA
- Post und Telegraf Direktion, Austria
- Department of Trade and Industry / Radio Communication Agency DTI / RCA, United Kingdom

Miscellaneous Approvals

- SIL 2 Safety Functions
- CE Mark, European Community
- TÜV Overfilling Protection, Germany
- TÜV Pressure Approval, Germany
- TÜV Firesafe Approval, Germany

In addition to the list above, there are a number of certificates or approvals for optional equipment which can be delivered.

Junction boxes, pressure transducers, water interface sensors, etc. have approvals in the name of their manufacturers. Copies of these can be requested from Emerson Process Management / Rosemount Tank Gauging.

Vapor Influence on Radar Measurement

For a few specific products there can be a measurable influence on the level accuracy, if the composition of the vapor varies between no vapor and fully saturated vapor condition. However, there is no noticeable influence, if the vapor variation is small.

For these specific products it is in many cases sufficient that the pressure and temperature is measured. The software in the Radar Tank Gauge then automatically corrects for the influence from the vapor. This is for example performed when measuring in LPG tanks.

Gases that are known to affect the transmission of radar waves are:

- Propylene oxide
- Etylether
- Propylether
- Acetaldehyde
- Propionaldehyde
- Isobutyraldehyde
- Acetone
- 2-Butanone
- Methanol

One gas that dampens (or attenuates) the radar signal is ammonia. In applications where ammonia is involved, Emerson Process Management / Rosemount Tank Gauging should always be contacted for evaluation of the application.

Ordering information

If you require other options than listed in the Ordering Information, please consult your local Rosemount Tank Gauging sales representative.

Radar Tank Gauge (RTG 3900)

Transmitter Head (TH)

Pos	Item	Code	Description	Note
1	**Transmitter Head**	**A**	Transmitter Head RTG 3900, ± 0.5 mm instrument accuracy	
		L	Transmitter Head RTG 3900 L, ± 3 mm instrument accuracy (1)	
2	**Ex. and Safety Certification**	**0**	None	
		B	Baseefa (ATEX)	
		T	Baseefa (ATEX) + TÜV (2) overfill	
		S	Baseefa (ATEX) + SIL 2 (2)	
		U	UL/ULc	
		L	UL/ULc + SIL 2 (2)	
		G	Baseefa (ATEX) + Gost (Russia)	
		E	IECEx	
		P	IECEx + TÜV (2) overfill	
3	**Accuracy Certification**	**0**	None	
		R	OIML R85 E (3)	
		M	BMS (3)	Belgium
		N	NMI (3)	Holland
		C	PTB Eich (3)	Germany
		Q	IPQ (3)	Portugal
		L	LNE (3)	France
		S	GOSStandard (3)	Russia
		A	CMI (3)	China
4	**Power Supply**	**S**	100-240 VAC	
		A	34-70 VAC / 48-99 VDC	
		L	20-28 VDC	
5	**Analog Output (Non-IS)**	**0**	None	
		P	One 4-20 mA, passive.(4) Requires external voltage supply.	
		A	One 4-20 mA, active.(4) Voltage supply from gauge.	
6	**Analog Input (IS)**	**0**	None	
		A	One 4-20 mA	
		B	Two 4-20 mA	
		1	One HART®	
		2	Two – One working as HART® master	
7	**Communication**	**R**	TRL/2 bus (Standard)	
		E	Enraf®	Requires EBM fieldbus modem during commissioning
		L	L&J® (4)(5)(7)	Supports water level input
		V	Varec® (4)(5)	
		W	Whessoe® (4)(5)	
		T	TIWAY® (4)(5)	
		G	GPE® (4)(5)(7)	
		U	Sakura® (4)(5)(6)	
		P	Profibus® DP (4)(5)	
		F	FOUNDATION™ fieldbus (non-IS) (4)(5)	Temperature via DAU not possible.
		1	FOUNDATION™ fieldbus (IS) (8)	Temperature via DAU not possible.
		4	RS485 Modbus	
		C	Tokyo Keiso® (4)(5)(10)	

Pos	Item	Code	Description	Note
8	**Relay Output**	**0**	None	
		1	One Relay Output	
		2	Two [5] [9]	
9	**Integrated Junction Box (JBi)**	**0**	None	
		1	Integrated Junction Box with NPT thread. [10] (EEx e/EEx i)	Plugs & glands included
		2	Integrated Junction Box with mm thread. [10] (EEx e/EEx i)	Plugs & glands included
		X	Other specified in order	
10	**Cable**	**C**	Default according to selected configuration.	
		B	Default for the US market (always with 15-wire cable at W12)	
11	**Metrological Seal**	**0**	None	
		E	External [2]	
		N	Internal [2]	
12	**Report**	**0**	None	
		1	Test & Delivery Certificate with measuring range print-out (1 copy). [2]	
		2	SP Test & Delivery Certificate with measuring range print-out (1 copy). [2]	Witnessed by Swedish Certifying Authority
13	**Temperature Inputs (IS)**	**0**	No temperature inputs	
		1	1-14 Temperature inputs via Data Aquisition Unit (DAU)	
		6	1-6 temperature inputs directly connected to gauge. Common return. -50 °C to +250 °C (-58 °F to +482 °F)	
		3	1-3 temperature inputs directly connected to gauge. individual wiring. -50 °C to +250 °C (-58 °F to +482 °F)	
14	**Support for Remote Display Unit, RDU 40 (IS)**	**0**	No	
		R	Yes	
15	**Special**	**0**	None	
		T	Printed TAG for unit identification	
		S	Stainless Steel TAG for unit identification	Must be specified 3 weeks prior to delivery

(1) Requires code 0 in Pos 3, 11 and 12.

(2) Requires Pos 8 “Relay Output” code 1 or 2.

(3) Requires Pos 1 “Transmitter Head” code A.

(4) Not available with Pos 8 “Relay Output” code 2.

(5) Requires Pos 5 “Analog Output” code 0.

(6) Requires Pos 6 “Analog Input” code 0.

(7) Not available with Pos 6 “Analog Input” code B, 1 and 2.

(8) Not available with Pos 6 “Analog Input” code B and 2.

(9) Not Available with Pos 7 “Communication” code L, V, W, T, G, U, P, F and C.

(10) Not available with Pos 2 “Ex. and Safety Certification” code U.

Antennas

RTG 3920 (Horn antenna)

Pos	Item	Code	Description	Material
16	**Antenna Type**	**20**	Horn antenna	
17	**Pressure Rating**	**S**	- 0.2 to 2 bar (-2.9 to 29 psig)	
18	**Antenna Size and Material**	**1A**	8 in. (Ø175 mm)	SST (2)
19	**Sealing**	**P**	PTFE	
20	**O-ring**	**V**	FPM (Viton®)	
21	**Special**	**0**	None	
		M	Material Certificate	
22	**Accessory**	**0**	Not applicable	
23	**Flange / Connection**	**1A**	8 in. Hole pattern according to ANSI 8 in. Class 150 / DN 200 PN 10 (1)	SST (2)
		1B	8 in. 4° Inclined. Hole pattern according to ANSI 8 in. Class 150 / DN 200 PN 10 (1)	

(1) Flat faced flange with 13 mm (0.51 in.) thickness.

(2) Material type corresponding to EN 1.4401 / AISI 316, EN 1.4404 / AISI 316L.

RTG 3930 (Parabolic antenna)

Pos	Item	Code	Description	Material
16	**Antenna Type**	**30**	Parabolic antenna	
17	**Pressure Rating**	**S**	- 0.2 to 0.2 bar (-2.9 to 2.9 psig)	
		H	- 0.2 to 10 bar (2.9 to 145 psig) (1)	
18	**Antenna Size and Material**	**1A**	Ø 440 mm (17 in.)	SST (2)
19	**Sealing**	**P**	PTFE	
20	**O-ring**	**V**	FPM (Viton®)	
21	**Special**	**0**	None	
		M	Material Certificate	
22	**Accessory**	**0**	Not applicable	
23	**Flange / Connection**	**2A**	Welded installation	SST (2)
		2B	Threaded installation	SST (2)

(1) Requires Pos 23 “Flange / Connection” code 2A (welded installation).

(2) Material type corresponding to EN 1.4401 / AISI 316, EN 1.4404 / AISI 316L.

RTG 3950 (Still-pipe Array antenna)

Pos	Item	Code	Description	Material
16	**Antenna Type**	**50**	Still-pipe Array antenna	
17	**Pressure Rating**	**S**	Pressure according to antenna mounting (Pos 19)	
18	**Antenna Size and Material**	**1A**	5 in.	EN 1.4404 / AISI 316L and PPS
		2A	6 in.	EN 1.4404 / AISI 316L and PPS
		3A	8 in.	EN 1.4404 / AISI 316L and PPS
		4A	10 in.	EN 1.4404 / AISI 316L and PPS
		5A	12 in.	EN 1.4404 / AISI 316L and PPS
19	**Mounting**	**1**	Fixed installation, - 0.2 to 2 bar (-2.9 to 29 psig)	
		3	Inclined Installation, - 0.2 to 0.25 bar (-2.9 to 3.6 psig)	Enables hand-dipping
20	**O-ring**	**0**	Not applicable	
21	**Special**	**0**	None	
		M	Material Certificate	
22	**Accessory**	**0**	None	
		C	Clamp Flange (for pipes without flange)	Galvanized Steel
		A	Adapter kit for insertion pipe (1)	
23	**Flange / Connection**	**4A**	Hole pattern according to ANSI 5 in. Class 150 (2) (3)	EN 1.4404 / AISI 316L
		4B	Hole pattern according to ANSI 6 in. Class 150 / DN 150 PN 16 (2) (3)	EN 1.4404 / AISI 316L
		4C	Hole pattern according to ANSI 8 in. Class 150 / DN 200 PN 10 (2) (3)	EN 1.4404 / AISI 316L
		4D	Hole pattern according to ANSI 10 in. Class 150 / DN 250 PN 16 (2) (3)	EN 1.4404 / AISI 316L
		4E	Hole pattern according to ANSI 12 in. Class 150 (2) (3)	EN 1.4404 / AISI 316L

(1) Requires Pos 18 “Antenna Size & Material” code 1A and Pos 23 “Flange / Connection” code 4A.

(2) Welded to hatch if inclined installation, Pos 19 “Mounting” code 3.

(3) Flat faced flange with 12 mm (0.47 in.) thickness.

RTG 3960 (LPG/LNG antenna)

Pos	Item	Code	Description	Rating	Material
16	**Antenna Type**	60	LPG/LNG Antenna		
17	**Pressure Rating**	A	Up to 25 bar, depending on flange rating in position 23		
18	**Antenna Size and Material**	1A	Cone 4 in. SCH 10		SST (1)
		1B	Cone DI = 99 mm		SST (1)
		1C	Cone 4 in. SCH 40		SST (1)
19	**Sealing**	Q	Quartz		
20	**Reference Measurement**	R	Reference measurement with Reflector Kit (1 pin included)		SST (1)
21	**Special**	0	None		
		M	Material Certificate for all pressurized details		
22	**Accessory**	2	Pressure Transmitter, ball valve 20 bar (290 psig), PV Kit (2)		
		7	Pressure Transmitter, other		
23	**Flange / Connection**	4A	Hole pattern according to ANSI 6 in. Class 150, thickness 28 mm (1.1 in.)	MAWP 10.4 bar at 90 °C (3)	SST (1)
		4B	Hole pattern according to ANSI 6 in. Class 300, thickness 38 mm (1.5 in.)	MAWP 21 bar at 90 °C (3)	SST (1)
		4D	Hole pattern according to ANSI 4 in. Class 150, thickness 28 mm (1.1 in.)	MAWP 10.4 bar at 130 °C (3)	SST (1)
		4E	Hole pattern according to ANSI 4 in. Class 300, thickness 34 mm (1.3 in.)	MAWP 21 bar at 100 °C (3)	SST (1)
		4F	Hole pattern according to ANSI 8 in. Class 150, thickness 25 mm (0.98 in.)	MAWP 10.4 bar at 90 °C (3)	SST (1)
		4G	Hole pattern according to ANSI 8 in. Class 300, thickness 43 mm (1.7 in.)	MAWP 21 bar at 100 °C (3)	SST (1)

(1) Corresponds to EN 1.4401 / AISI 316, EN 1.4404 / AISI 316L.

(2) Requires Pos 6 “Analog Input” code A, B, 1 or 2.

(3) Raised face flange, gasket group 1A or 1B according to ASME B 16.5.

Model Code Example

TH - Antenna: RTG 3900 - A B 0 S A 0 R 0 2 C 0 0 6 R 0 - 30 S 1A P V M 0 2A

Data Acquisition Unit (DAU 2100)

Pos	Item	Code	Description	Note
1	**Type**	**00**	Data Acquisition Unit	
2	**Power Supply**	**0**	Powered by RTG	
3	**Temperature Range**	**1**	- 50 °C to +125 °C (-58 °F to +257 °F)	
		2	- 50 °C to +300 °C (-58 °F to +572 °F)	
		3	- 200 °C to +150 °C (-328 °F to +302 °F)	
4	**Adapter for German "Eich"**	**0**	None. Standard Pt-100 version.	
		3	Pt-100 (Eich) (1)	
		4	Cu-90 (Eich) (1)	
5	**Aluminium Housing**	**A**	Included	
6	**Display**	**0**	None	
		Y	Included	
7	**Ex. Certification**	**U**	Baseefa (ATEX) / UL / ULc (Std)	
		E	IECEx	
8	**Other Certification**	**0**	None	
		S	German "Eich" Sign & Seal	
		N	NMI	
		X	Other specified in order	
9	**Accessory**	**0**	None	
		W	Sun Shelter Kit	
		T	Printed TAG for unit identification	
		S	Stainless Steel TAG for unit identification	

(1) Only for systems with Pos 3 "Accuracy Certification" code C, Eich (German), for Transmitter Head.

Model Code Example

DAU 2100 - 00 0 1 0 A Y U 0 S

Remote Display Unit (RDU 40)

Item	Model/Code	Description	Note
Display Unit	**RDU 40**	Remote Display Unit	

Junction Box and Protective Hose Kit

Item	Model/Code	Description	Note
Junction Box	**JB 1401**	Junction Box, EEx e (JB 140-11)	
	JB 1405	Junction Box, EEx i (JB 140-15)	
	JB 36	Junction Box, for connection of temperature sensors to DAU	Up to 12 sensors if 3-wire
	JB 42	Junction Box, for connection of temperature sensors to DAU	Up to 14 sensors if 3-wire
Miscellaneous	**PHK 39S**	Protective Hose Kit (PHK), 2 m (6.6 ft) (1)	
	PHK 392	Protective Hose Kit (PHK), 20 m (65.6 ft) (1)	

(1) Between Rex gauge and Junction Box.

Field Communication Unit (FCU 2160)

Pos	Item	Code	Description	Note
1	**Version**	**60**	OPI/2 & TankMaster compatible	FCU is TRL2 / Rex compatible
2	**Power Supply**	**1**	115 VAC	
		2	230 VAC	
3	**Port 1**	**G1**	GroupBus, TRL/2 bus	
		G3	GroupBus, RS485 bus	
		G5	GroupBus, RS232 bus	
4	**Port 2**	**G1**	GroupBus, TRL/2 bus	
		G3	GroupBus, RS485 bus	
		G5	GroupBus, RS232 bus	
5	**Port 3**	**F1**	FieldBus, TRL/2 bus	
6	**Port 4**	**F1**	FieldBus, TRL/2 bus	
7	**Port 5**	**F1**	FieldBus, TRL/2 bus	
		G1	GroupBus, TRL/2 bus	
		G3	GroupBus, RS485 bus	
8	**Port 6**	**F1**	FieldBus, TRL/2 bus	
		G1	GroupBus, TRL/2 bus	
		G3	GroupBus, RS485 bus	
9	**Communication**	**S**	OPI / TankMaster	
	Protocol	**M**	Modbus to other Host	Required for communication with Host
10	**Extended Function**	**0**	None	
		R	Redundancy Function	Requires a second FCU with Redundancy
		B	Buddy Mode	
11	**Special**	**0**	None	
12	**Accessory**	**0**	None	
		W	Sun Shelter Kit	
13	**Sign**	**S**	Standard sign	
		M	NMI	
		X	Other specified in order	

Model Code Example
FCU 2160 - 60 2 G1 G5 F1 F1 F1 F1 S R 0 W S

Field Communication Unit (FCU 2165/2175)

The FCU 2165 has 10 ports. Port 1 is reserved for Ethernet and Port 4 is an Engineering port. Ports 5, 6, 11, and 12 are RS232 only.
Baud rate and communication settings must be the same for:

- Ports 2 and 6
- Ports 7, 8, 11, and 12

Port 2 or 3 is recommended for tank gauging hosts.

The ports of the FCU 2175 can be configured freely. It is delivered with 8, 16, 24, or 32 ports.

Hosts
Modbus Slave, Generic (DCS, SCADA etc)
TankMaster Modbus (TankMaster PC, DCS, SCADA)
Microlect™ emulation (OMS, DCS, SCADA)
CIU 858 emulation (Entis™, DCS, SCADA)

Field Slaves	Interface type (Connected equipment)	Devices per port
Enraf®	CIU 858 bus (CIU 858 or CIU 880 Prime configured for 858 emulation)	10 CIU:s
	CIU 880 Prime	10 CIU:s
	GPP bus (801, 802, 811, 812, 813, 856, and others)	10
	GPU bus (811, 812, 813, 854, 872, 873, 877, 970, 971, 973, and others)	10
Whessoe®	WM 500	16 Outstations
	WM 550 (WM 550, ITG 50, 60, and 70)	32
Rosemount	FCU RS232	1 FCU
	FCU RS485	32 FCU:s
	TRL/2 bus (TRL/2, Rex, Pro)	8
Motherwell®	Motherwell 4000	1
	Motherwell 2800 i (MCS 2800)	32
Generic	Modbus Master (Modbus Master RTU / RS232)	

For more information and protocol options, please contact your local Rosemount Tank Gauging sales representative.

Field Bus Modems

Item	Model/Code	Description	Note
Field Bus Modem	**FBM 2180**	Standard Rex. RS232, USB, Modbus	
	EBM 3180	For configuration of Rex on Enraf® fieldbus	

TankMaster™ Software

Pos	Item	Code	Description	Note
1	**Licence**	**DM**	TankMaster Demo	No hardware key included
		WS	TankMaster WinSetup	Configuration only. No hardware key included
		05	TankMaster WinOpi, with TankServer for up to 5 tanks (1)(2)	One hardware key included
		20	TankMaster WinOpi, with TankServer for up to 20 tanks (1)(2)	One hardware key included
		50	TankMaster WinOpi, with TankServer for up to 50 tanks (1)(2)	One hardware key included
		MX	TankMaster WinOpi Max (1)	Unlimited number of tanks. One hardware key included
2	**Host Communication**	**0**	None	
		C	Host Communication (3)	
		S	Host Communication (3) + Office Link (4)	
3	**Network**	**0**	None	
		N	Network enabled (5)	Used for TM WinOpi Clients in the network
4	**Custody Transfer**	**0**	None	
		C	Custody transfer functions (6)	
5	**Extended Batch Handling**	**0**	None	
		B	Custody transfer batch handling system	
6	**HTG**	**0**	None	
		P	TankMaster Hydrostatic Tank Gauging Functions	
7	**Customization**	**0**	None	
		C	Customized Views	
8	**Redundancy**	**00**	None	
		R0	Redundancy	

(1) Configuration, view and alarm handling. Volume calculations according to API and others. Includes WinSetup.

(2) To view unlimited number of tanks if Pos 3 “Network” code N.

(3) For connection between TankMaster and SCADA / DCS via Modbus (RS232). Includes OPC Server and Slave Protocol. Requires WinOpi.

(4) For connection between TankMaster and Microsoft® Office via OPC Server. Client/Site Server Licence.

(5) Enables viewing of all installed tanks in the network from any TankMaster PC, independent of WinOpi type.

(6) Custody Transfer windows. Includes Hardware key, Custody Transfer seal and Metrological seal for Custody Transfer approvals.

Model Code Example

TM - 20 S N C 0 P C R0

For upgrade of your TankMaster software please contact your sales representative (requires software key number).

TankMaster.net Software & I/O Terminals

Item	Model/Code	Description	Note
TankMaster.net	**RTM39EL**	TankMaster.net (1), Single Licence (one user).	
	RTM39EM	TankMaster.net (1), Limited Licence (up to 3 users).	
	RTM39ES	TankMaster.net (1), Site Licence (unlimited number of users).	
I/O Terminals	**IOM 5110 AI**	I/O Terminals, Analog In, 16 channels (2)	Connected to TankMaster PC
	IOM 5120 AO	I/O Terminals, Analog Out, 16 channels (2)	Connected to TankMaster PC
	IOM 5130 DI	I/O Terminals, Digital In, 16 channels (2)	Connected to TankMaster PC
	IOM 5140 DO	I/O Terminals, Digital Out, 8 channels (2)	Connected to TankMaster PC

(1) Tank data availability through Internet / Intranet. Requires TankMaster WinOpi.

(2) Protective hose is included. Power supply (24 VDC) is required, but not included. TankMaster Customized views option is recommended.

Temperature and Water Level Sensors

For the US and Canadian markets, see page 60.

Multispot Temperature Sensor (MST)

Pos	Item	Code	Description	Note
1	**Overall Length, Temperature Sensor**	**05000-70000**	Specify length in millimetres	
2	**Sheath Type**	**A**	1 in. AISI 316	
		B	Standard. ¾ in. AISI 316 (1)	
3	**Connection Type**	**1**	Threaded, ½ in. BSP	
		5	Flange, 1 ½ in. ANSI 150 psi	
		6	Flange, 2 in. ANSI 150 psi	
		7	Flange, 3 in. ANSI 150 psi	
4	**Temperature Sensor Wiring**	**3**	3-wire, Individual	
		C	Common return	
5	**Number of Temperature Spot Elements**	**01 to 14**	Specify number	
6	**Element Type**	**P**	Pt-100	
7	**Temperature Accuracy Class**	**1**	1/6 DIN Class B	
		2	1/10 DIN Class B	
8	**Temperature Range** (2)	**1**	- 50 °C to +120 °C (-58 °F to +248 °F)	
		2	-20 °C to +250 °C (-4 °F to +482 °F)	
9	**Lead Wire, Temperature Sensor**	**01**	500 mm (1.6 ft) for Junction Box connection	
		03	Standard. 3 m (10 ft)	
		04 to 10	Specify other length in metres	Maximum 10 m (33 ft) is recommended
10	**Anchor Weight**	**0**	None	
		A	2.5 kg (5.5 lbs), Ø= 40 x 200 mm (1.6 x 7.9 in.)	For still-pipes
		B	3 kg (6.6 lbs), Ø= 50 x 200 mm (2.0 x 7.9 in.)	For still-pipes
		C	4 kg (8.8 lbs), Ø= 45 x 330 mm (1.8 x 13.0 in.)	For still-pipes
		D	5 kg (11 lbs), Ø= 100 x 85 mm (3.9 x 3.3 in.)	For free-hanging
		E	10 kg (22 lbs), Ø= 95 x 175 mm (3.7 x 6.9 in.)	For free-hanging
		F	15 kg (33 lbs), Ø= 140 x 130 mm (5.5 x 5.1 in.)	For free-hanging
11	**Junction Box**	**0**	None	
		1	Junction Box integrated with temperature sensor	For up to 11 spots with 3-wire return, or 14 spots with common return
		3	JB 42	
12	**Hose Kit**	**00**	None	
		03	Hose kit including glands, 3 m (10 ft) as standard	
		10	Hose kit including glands, 10 m (33 ft)	
13	**Vapor Boot**	**0**	None	
		1	2 in. NPS Threaded	
		2	3 in. NPS Threaded	
		3	Flange, 3 in. ANSI 150 psi	
		4	Flange, 4 in. ANSI 150 psi	
		6	Flange, 6 in. ANSI 150 psi	
		8	Flange, 8 in. ANSI 150 psi	

(1) Requires Pos 4 “Temperature Sensor Wiring” code C (common return) for more than 8 spot elements.

(2) Version available for - 170 °C to +100 °C (-274 °F to +212 °F). This temperature sensor (NL-Cryo) is specified separately.

Note: Spot positions should be specified separately in Required System Information (RSI).

Model Code Example
MST - 15000 A 6 C 14 P 2 1 01 C 3 00 0

Water Level Sensor Integrated with Multispot Temperature Sensor (MSTW)

Pos	Item	Code	Description	Note
1	**Overall Length, Temperature Sensor**	**05000-70000**	Specify length in millimetres	
2	**Sheath Type**	**A**	1 in. AISI 316	
3	**Connection Type**	**4**	M33x1.5	
		5	Flange, 1 ½ in. ANSI 150 psi	
		6	Flange, 2 in. ANSI 150 psi	
		7	Flange, 3 in. ANSI 150 psi	
		8	DN 100 / PN 10	
4	**Temperature Sensor Wiring**	**3**	3-wire, Individual	
		C	Common return	
5	**Number of Temperature Spot Elements**	**00**	No temperature sensor – Water Level Sensor (WLS) only	
		01 to 14	Specify number	
6	**Element Type**	**P**	Pt-100	
7	**Temperature Accuracy Class**	**0**	None	
		1	1/6 DIN Class B	
		2	1/10 DIN Class B	
8	**Temperature Range**	**1**	- 50 °C to +120 °C (-58 °F to +248 °F)	
9	**Lead Wire, Temperature Sensor**	**01**	500 mm (1.6 ft) for Junction Box connection	
		03	Standard. 3 m (10 ft)	
		04 to 10	Specify other length in metres	Maximum 10 m (33 ft) is recommended
10	**Anchor Weight**	**0**	None	
		D	5 kg (11 lbs), Ø=100x85 mm (3.9 x 3.3 in.)	For free-hanging installation
		E	10 kg (22 lbs), Ø=95x175 mm (3.7 x 6.9 in.)	For free-hanging installation
		X	Customized	
11	**Junction Box**	**0**	None	
		1	Junction Box integrated with temperature sensor	For up to 10 spots with 3-wire return + WLS, or 14 spots with common return + WLS
		3	JB 42	
12	**Hose Kit**	**00**	None	
		03	Hose kit including glands, 3 m (10 ft) as standard	
		10	Hose kit including glands, 10 m (33 ft)	
13	**Vapor Boot**	**0**	None	
		1	2 in. NPS Threaded	
		2	3 in. NPS Threaded	
		3	Flange, 3 in. ANSI 150 psi	
		4	Flange, 4 in. ANSI 150 psi	
		6	Flange, 6 in. ANSI 150 psi	
		8	Flange, 8 in. ANSI 150 psi	
14	**Water Level Sensor (integrated)**	**C05**	Closed; for light products, 500 mm (19.7 in.) range	
		C10	Closed; for light products, 1000 mm (39.4 in.) range	
		H05	Open; for heavy products, 500 mm (19.7 in.) range	
		H10	Open; for heavy products, 1000 mm (39.4 in.) range	
15	**Water Level Sensor, Top Weight**	**0**	None	
		T	5 kg (11 lbs)	

Note: Spot positions should be specified separately in Required System Information (RSI).

Model Code Example
MSTW - 15000 A 6 C 14 P 1 1 03 D 0 00 0 C10 T

Single Spot Temperature Sensor (SST)

Pos	Item	Code	Description	Note
1	**Resistance Thermometer Type**	**1**	Type B, with extension length & removable insert	
		2	Type BF, with extension length & fixed insert	
		3	Type OPE, with Ex head and extension length plus fixed insert	
2	**Length**	**0500**	500 mm (1.6 ft) as standard	
		0200-2000	Customized. Specify length in millimetres	
3	**Sheath Dimension**	**A**	Ø=8 mm (0.31 in.), 1 mm (0.04 in.) thickness (1)	
		B	Ø=9 mm (0.35 in.), 1 mm (0.04 in.) thickness	
		C	Ø= 11 mm (0.43 in.), 1 mm (0.04 in.) thickness (2) (3)	
4	**Extension Length**	**080**	80 mm (3.15 in.)	
		145	145 mm (5.71 in.)	
5	**Mounting Thread**	**1**	½-in. BSP	
		2	¾-in. BSP (3) (4)	
		4	½-in. NPT	
6	**Number of Wires**	**3**	Three	
7	**Number of Elements**	**1**	1xPt	
		2	2xPt	
8	**Element Type**	**P**	Pt-100	
9	**Temperature Accuracy Class**	**1**	1/6 DIN ± 0.05 °C (± 0.09 °F)	
10	**Temperature Range**	**1**	-50 °C to +260 °C (-58 °F to +500 °F) (4)	
		2	-50 °C to +400 °C (-58 °F to +752 °F)	
11	**Cable Outlet**	**1**	½-in. NPT (5)	
		2	½-in. BSP (5)	
		3	M20 (4)	

(1) Requires Pos 1 “Resistance Thermometer Type” code 2.

(2) Requires Pos 1 “Resistance Thermometer Type” code 1.

(3) Can not be combined with Thermowell.

(4) Requires Pos 1 “Resistance Thermometer Type” code 1 or 2.

(5) Requires Pos 1 “Resistance Thermometer Type” code 3.

Model Code Example

SST - 3 0500 B 080 1 3 1 P 1 2 1

Thermowell for Single Spot Temperature Sensor (SSTW), pressurized tanks

Pos	Item	Code	Description	Note
1	**Thermowell Length**	**0250-2000**	Specify length in millimetres	Made of 316 SST
2	**Thermowell Sheath Dimension**	**A**	Ø=16 mm (0.63 in.), 3 mm (0.12 in.) thickness	
		B	Ø=21.3 mm (0.84 in.), 2.65 mm (0.10 in.) thickness	
3	**Thermowell Flange Connection**	**1**	1.5 in. ANSI 150 Psi	
		2	2 in. ANSI 150 Psi	
		3	1.5 in. ANSI 300 Psi	
		4	2 in. ANSI 300 Psi	
		5	DN50 / PN10 - PN16	
		6	DN50 / PN40	
4	**SST Mounting Thread**	**1**	½-in. NPT	
		2	½-in. BSP	

Model Code Example

SSTW - 0250 A 2 2

Temperature and Water Level Sensors for the US and Canada

Multispot Temperature Sensor (MSTUS) for the US and Canada

Pos	Item	Code	Description	Note
1	**Overall Length, Temperature Sensor**	**U0038-U2756**	Specify length in **even** inches only	
2	**Sheath Type**	**A**	1 in. AISI 316	
		B	¾ in. AISI 316 (1)	
3	**Connection Type**	**A**	Threaded, ¾ in. NPS	
		5	Flange, 1 ½ in. ANSI 150 psi	
		6	Flange, 2 in. ANSI 150 psi	
		7	Flange, 3 in. ANSI 150 psi	
		C	Flange, 4 in. ANSI 150 psi	
		D	Flange, 6 in. ANSI 150 psi	
		E	Flange, 8 in. ANSI 150 psi	
		F	Flange, 10 in. ANSI 150 psi	
4	**Temperature Sensor Wiring**	**3**	3-wire, individual	
		C	Common return	
5	**Number of Temperature Spot Elements**	**01 to 14**	Specify number	
6	**Element Type**	**P**	Pt-100	
7	**Temperature Accuracy Class**	**1**	1/6 DIN Class B	
		2	1/10 DIN Class B	
8	**Temperature Range** (2)	**1**	-58 °F to +248 °F	
		2	-4 °F to +482 °F	
9	**Lead Wire, Temperature Sensor**	**01**	1.6 ft for Junction Box connection	
		03	Standard. 10 ft	
		13 to 33	Specify other length in **even** feet only	Maximum 33 ft is recommended
10	**Anchor Weight**	**00**	None	
		01	5 lbs, for still-pipes and 2 in. openings	
		02	20 lbs, for still-pipes and 2 in. openings	
		03	30 lbs, for still-pipes and 2 in. openings	
		04	6 lbs (Ø=2 in.), for free-hanging	
		05	11 lbs (Ø=3.9 in.), for free-hanging	
		06	22 lbs (Ø=3.7 in.), for free-hanging	
		07	33 lbs (Ø=5.5 in.), for free-hanging	
11	**Junction Box**	**0**	None	
		4	Junction Box integrated with temperature sensor	US version for up to 11 spots with 3-wire return, or 14 spots with common return
12	**Hose Kit**	**00**	None	
13	**Vapor Boot**	**0**	None	
		1	2 in. NPS Threaded	
		2	3 in. NPS Threaded	
		3	Flange, 3 in. ANSI 150 psi	
		4	Flange, 4 in. ANSI 150 psi	
		6	Flange, 6 in. ANSI 150 psi	
		8	Flange, 8 in. ANSI 150 psi	

(1) Requires Pos 4 “Temperature Sensor Wiring” code C (common return) for more than 8 spot elements.

(2) Version available for -274 °F to +212 °F. This temperature sensor (NL-Cryo) is specified separately.

Note: Spot positions should be specified separately in **text** portion of order.

Model Code Example
MSTUS - U0480 B 5 C 06 P 1 2 01 06 4 00 0

Water Level Sensor Integrated with Multispot Temperature Sensor (MSTWUS) for the US and Canada

Pos	Item	Code	Description	Note
1	**Overall Length, Temperature Sensor**	**U0038-U2756**	Specify length in **even** inches only	
2	**Sheath Type**	**A**	1 in. AISI 316	Maximum 20 spot elements
3	**Connection Type**	**5**	Flange, 1 ½ in. ANSI 150 psi	
		6	Flange, 2 in. ANSI 150 psi	
		7	Flange, 3 in. ANSI 150 psi	
		C	Flange, 4 in. ANSI 150 psi	
		D	Flange, 6 in. ANSI 150 psi	
		E	Flange, 8 in. ANSI 150 psi	
		F	Flange, 10 in. ANSI 150 psi	
4	**Temperature Sensor Wiring**	**3**	3-wire, Individual	
		C	Common return	
5	**Number of Temperature Spot Elements**	**00**	No temperature sensor – Water Level Sensor (WLS) only	
		01 to 14	Specify number	
6	**Element Type**	**P**	Pt-100	
7	**Temperature Accuracy Class**	**1**	1/6 DIN Class B	
		2	1/10 DIN Class B	
8	**Temperature Range**	**1**	-58 °F to +248 °F	
9	**Lead Wire, Temperature Sensor**	**01**	1.6 ft for Junction Box connection	
		03	Standard. 10 ft	
		13 to 33	Specify other length in **even** feet only	Maximum 33 ft is recommended
10	**Anchor Weight**	**00**	None	
		01	5 lbs, for still-pipes and 2 in. openings	
		04	6 lbs (Ø=2 in.), for free-hanging	
		05	11 lbs (Ø=3.9 in.), for free-hanging	
11	**Junction Box**	**0**	None	
		4	Junction Box integrated with temperature sensor	US version for up to 10 spots with 3-wire return + WLS, or 14 spots with common return + WLS
12	**Hose Kit**	**00**	None	
13	**Vapor Boot**	**0**	None	
		1	2 in. NPS Threaded	
		2	3 in. NPS Threaded	
		3	Flange, 3 in. ANSI 150 psi	
		4	Flange, 4 in. ANSI 150 psi	
		5	Flange, 6 in. ANSI 150 psi	
		6	Flange, 8 in. ANSI 150 psi	
14	**Water Level Sensor (integrated)**	**C05**	Closed; for light products, 19.7 in. range	
		C10	Closed; for light products, 39.4 in. range	
		H05	Open; for heavy products, 19.7 in. range	
		H10	Open; for heavy products, 39.4 in. range	
15	**Water Level Sensor, Top Weight**	**0**	None	
		1	10 lbs	

Note: Spot positions should be specified separately in Required System Information (RSI).

Model Code Example
MSTWUS - U0480 A 5 C 06 P 1 1 01 00 4 00 0 C05 1

Single Spot Temperature Sensor (SSTUS) for the US and Canada

Pos	Item	Code	Description	Note
1	**Resistance Thermometer Type**	**3**	Type OPE, with Ex head and extension length plus fixed insert. Standard.	
2	**Length**	**U036**	36 in.	
		U008-U080	Customized. Specify length in **even** inches only	
3	**Sheath Dimension**	**D**	Ø=0.24 in.	
4	**Extension Length**	**080**	3.15 in.	
		145	5.71 in.	
5	**Mounting Thread**	**4**	½-in. NPT	
6	**Number of Wires**	**3**	Three	
7	**Number of Elements**	**1**	1xPt	
		2	2xPt	
8	**Element Type**	**P**	Pt-100	
9	**Temperature Accuracy Class**	**1**	1/6 DIN ± 0.09 °F	
10	**Temperature Range**	**4**	-58 °F to +932 °F	
11	**Cable Outlet**	**1**	½-in. NPT	

Model Code Example
SSTUS - 3 U036 D 080 4 3 1 P 1 4 1

Thermo Well for Single Spot Temperature Sensor (SSTWUS), pressurized tanks, for the US and Canada

Pos	Item	Code	Description	Note
1	**Thermowell Length**	**U008-U080**	Specify length in **even** inches only	Made of 316 SST
2	**Thermowell Sheath Dimension**	**B**	Ø=0.84 in, 0.10 in. thickness	
3	**Thermowell Flange Connection**	**1**	1.5 in. ANSI 150 Psi	
		2	2 in. ANSI 150 Psi	
		3	1.5 in. ANSI 300 Psi	
		4	2 in. ANSI 300 Psi	
		5	DN50 / PN10 - PN16	
		6	DN50 / PN40	
		7	1 in. NPT	
4	**SST Mounting Thread**	**1**	½-in. NPT	

Model Code Example
SSTWUS - U036 B 2 1

Pressure Transmitters

For more information on pressure transmitters, see the Rosemount 3051S Product Data Sheet (00813-0100-4801) or www.rosemount.com.

Pressure Transmitter, Rosemount 3051S Series Liquid Level

Pos	Item	Code	Description	Note
1	**Transmitter Type**	**3051S**	Scalable pressure transmitter	
2	**Performance Class**	**1**	Ultra: 0.065 % span accuracy, 100:1 rangedown	Limited 12-year warranty
		2	Classic: 0.065% span accuracy, 100:1 rangedown	
3	**Connection Type**	**L**	Level	
4	**Measurement Type**	**G**	Gauge	
5	**Pressure Range**	**3A**	-393 to 1000 inH_2O (-0.98 to 2.5 bar)	
6	**Output**	**A**	4-20 mA with digital signal based on HART® protocol	
7	**Housing Style, Material & Conduit**	**2A**	Junction Box Housing, Aluminium, 1/2-14 NPT	
		2B	Junction Box Housing, Aluminium, M20 x 1.5 (CM20)	
8	**Seal System Type**	**1**	Direct-mount diaphragm seal system	
9	**High Pressure Side Extension**	**0**	Direct-mount (no extension)	
10	**Low Pressure Side Connection**	**2**	316L SST isolator / 316 SST transmitter flange	
11	**Capillary Length**	**0**	N/A	
12	**Diaphragm Seal Fill Fluid**	**D**	D.C. Silicone 200	
13	**Process Connection Style**	**FF**	Flush flanged, Ra 125-250 gasket surface	
14	**Diaphragm Seal Size**	**G**	2-in. / DN50	
		7	3-in.	
15	**Flange Rating**	**1**	Class 150	
16	**Isolator Material**	**CA**	316L SST. Flange material, high side: CS.	
		DA	316L SST. Flange material, high side: 316 SST.	
17	**Lower Housing Material**	**0**	None	
18	**Flushing Connection**	**0**	None	
19+	**Options**	**I1**	ATEX Intrinsically Safe	
		Q4	Calibration certificate	
		Q8	Material Traceability Certification per EN 10204 3.1B	

Pressure Transmitter , Rosemount 3051S Series Coplanar

Pos	Item	Code	Description	Note
1	**Transmitter Type**	**3051S**	Scalable pressure transmitter	
2	**Performance Class**	**1**	Ultra: 0.025 % span accuracy, 200:1 rangedown	10-year stability, limited 12-year warranty
		2	Classic: 0.055% span accuracy, 100:1 rangedown	5-year stability
3	**Connection Type**	**C**	Coplanar	
4	**Measurement Type**	**G**	Gauge	
5	**Pressure Range**	**3A**	-393 to 1000 inH_2O (-0.98 to 2.5 bar)	
6	**Isolating Diaphragm**	**2**	316L SST	
7	**Process Connection**	**G11**	Vertical mount level flange, 2 in. ANSI class 150	316 SST
		G21	Vertical mount level flange, 3 in. ANSI class 150	316 SST
8	**Output**	**A**	4-20 mA with digital signal based on HART® protocol	
9	**Housing Style**	**2A**	Junction Box Housing, Aluminium, 1/2-14 NPT	
		2B	Junction Box Housing, Aluminium, M20 x 1.5 (CM20)	
10+	**Options**	**I1**	ATEX Intrinsically Safe	
		L4	Bolting option: Austenitic 316 SST bolts	
		Q4	Calibration certificate	
		Q8	Material Traceability Certification per EN 10204 3.1B	

Model Code Example

3051S1LG3AA2B1020DFFG1DA00I1Q4
3051S1CG3A2G11A2AI1L4Q4

Patents

The products in this description may be protected by the following patents:

Australia	578279, 623980, 616357, 600679, others pending
Belgium	0167505, 0457801, 0419636, 0324731, others pending
Brazil	PI 8501945, PI 8502625, others pending
Canada	1294357, 2044584, others pending
China, PRC	85103379.2, 85104668.1, others pending
Croatia	Patents pending
Denmark	160374, 161261, 0457801, 0419636, others pending
Finland	73836, 80961, others pending
France	0167505, 0457801, 0419636, 0324731, 0592584, others pending
Germany	0167505, 69008514.108, P69005245.6-08, P3688141.408, 69216407.3-08, 0988661, others pending
India	164742, 164799
Italy	0457801, 0419636, 0324731, others pending
Japan	1734107, 1952353, 1881864, 3030518, others pending
Kuwait	Patents pending
Mexico	158252, 158486
Norway	166345, 172911, 304667, others pending
Saudi Arabia	21, others pending
Slovenia	Patents pending
South Korea	36650, 72075, 69686, 82937, others pending
Spain	0542528, 0543730, 0457801, 0419636, others pending
Sweden	8402247-4, 8402960-2, 8900424-6, 8901260-3, 8504317-2, 9102087-5, 0592584, 9702235-4, others pending
The Netherlands	0167505, 0457801, 0419636, 0324731, 0592584, others pending
USA	4641139, 4665403, 5136299, 5070730, 4933915, 5543720, 6278411, 6684697, 6629458, others pending
United Kingdom	0167505, 0457801, 0419636, 0324731, 0592584, 0988661, others pending
Venezuela	47537, 47606

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